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CLINICAL STUDY OF REPAIR OF BONE AFTER ALVEOLECTOMY

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Despite the widespread use of surgical procedures as a preliminary to modern denture practice, the alveolectomy, in all of its phases, has not been the subject of experiments which its importance would seem to warrant. The optimum time for the construction of dentures after operation, the basis of choice for complete or sectional alveolectomy, the effect on healing of elevating the periosteum from bone over a considerable area and the subsequent changes during healing in both periosteum and bone are topics that have not had more than casual investigation. Studies that do exist in this general field have approached tissue changes from another aspect, usually that of removing tumorous growths from the upper and lower jaws. Although these operations share a few common purposes with the alveolectomy, both the reason for and the approach to the alveolectomy are considerably different.

Less than two decades have elapsed since the first experimental alveolectomy was reported in the literature.[1] Most of the previous studies, and most since that time, have dealt with clinical experiences and observations. Claflin,[2] in 1936, reported experimental work on alveolectomies. Euler,[3] W. Meyer[4] and Balogh[5] have also reported in this and closely associated fields.

Read at the twenty-seventh annual meeting of the American Society of Oral Surgeons, Chicago, February 8, 1946. Revision of manuscript, The Effects of Elevating Periosteum from Bone.

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2. Claflin, R. S., Healing of Disturbed and Undisturbed Extraction Wounds. *J.A.D.A.* 23:945 (June) 1936.

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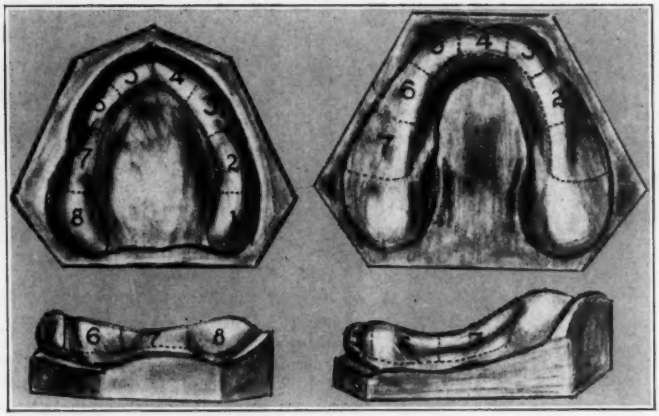

Fig. 1.—Diagrams illustrating areas on maxillary (left) and mandibular (right) ridges from which specimens were obtained

In another phase of reparative study, Pendelton[6] has demonstrated the histologic changes occurring in the tissues of persons who had worn full dentures. He cites the works of Brinch,[7] Mentz[8] and Wright[9] in connection with histopathologic changes occurring under the stresses of a full denture. These studies, extensive and original as they were, were made on tissue taken at autopsy, and the essential differences between this and living tissue must again be noted.

MacEwen[10] has made an important study of bone growth and also has devoted considerable attention to the periosteum in various experiments dealing with healing and repair.

The fact that many studies were made on dogs or with human material taken at autopsy prevented the establishment of strict parallels to operations and observations on living human tissues.

There has been good reason to believe that healing processes, such as are manifested after alveolectomy, follow closely the healing processes of bone elsewhere in the body. Arey,[11] Murray,[12] Pollock,[13] Rowell[14] and Saunders[15] have studied wounds of this type and have concluded almost unanimously that internal wounds of the serous and mucous surfaces differ in no fundamental way from wounds of the external surface.

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6. Pendelton, E. C., Reaction of Human Jaws to Prosthetic Dentures. *J.A.D.A.* 27:171 (May) 1940.

7. Brinch, Ove, Histologische Untersuchungen über Pathologischanatomisch Veränderungen im Gaumengewbe Prosthesentragender Patienten. *Vierteljahrschr. f. Zahnheilk.* 48:120, 1932.

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15. Saunders, R. L., Some Structural and Functional Features of the Alveolar Process in Relation to the Practice of Immediate Denture Service. *J. Canad. D. A.* 7:350 (July) 1941.

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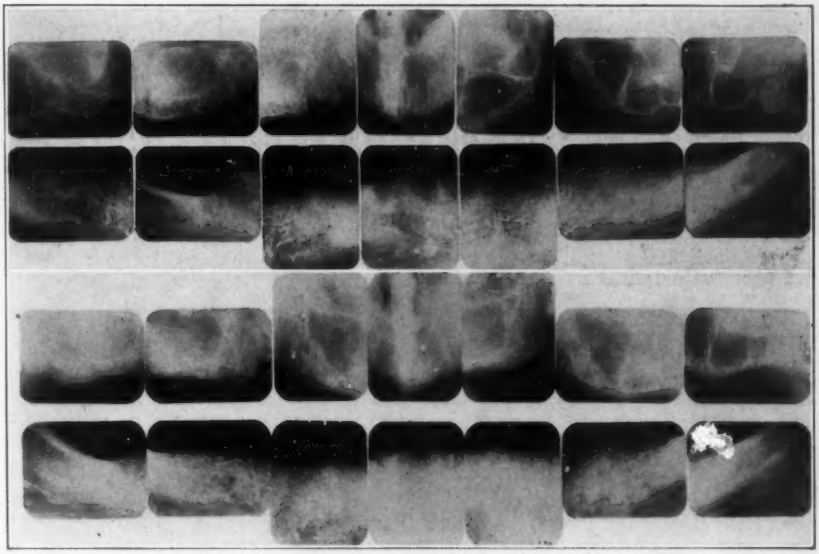

Fig. 2.—Preoperative (upper) and postoperative (lower) roentgenograms showing structure and contour of ridges

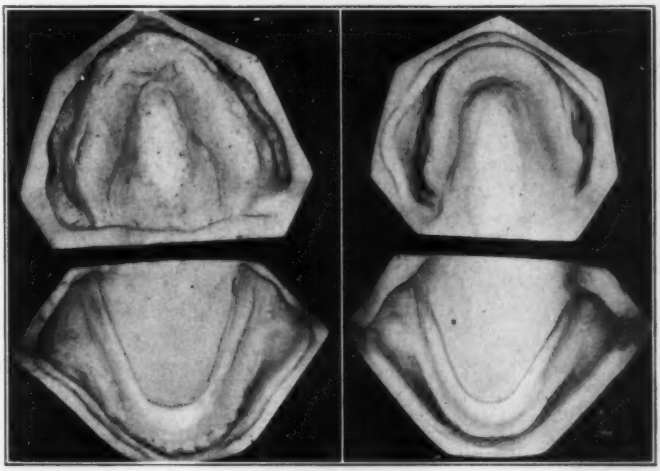

Fig. 3.—Photographs of casts made preoperatively (left) and postoperatively (right), showing structure and contour of ridges

Figures 1, 2, 3, 14, 16 and 20 were published previously as illustrations for The Effect of Elevating Periosteum from Bone. *Bur* 42:105 (November) 1942.

Fig. 4.—Surgical pack over section of alveolar ridge, left in position 3 or 4 days

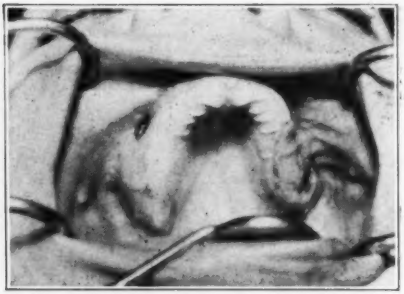

Fig. 5.—Healing of the tissues during the transformation stage is shown

The present study was undertaken, therefore, not to repeat previous experimental work but to attempt to establish definite relationships to the problems of the oral surgeon who performs the operation, and of the dentist who must construct full dentures upon this surgically established base. The study was made possible by the opportunity of securing two patients on whom extensive and time-consuming procedures could be undertaken with their full cooperation.

METHOD OF STUDY

The usual alveolectomy is performed by reflecting the periosteum, removing the underlying bone in predetermined regions and amounts, trimming the excess tissues to secure good approximation and placing sutures. In the present study the sectional method was employed. An incision was made over the entire crest of the alveolar ridge, and the periosteum was elevated over the entire region. In order to simulate the conditions of the alveolectomy, the flap was retracted for the period of time usually required for such operations, and the alveolar bone and periosteum were dried and sponged frequently. Normal saline solution was used to irrigate the involved parts, and sutures were placed. After periods ranging from two to fifty-three days, sections of the alveolar ridge and of the overlying soft structures were removed for study (Fig. 1). This procedure provided an opportunity for sectioning the tissues in order to study the extent and progress of healing which had occurred during these varying intervals.

CASE 1

An unemployed white man, aged 58, had edentulous mandibular and maxillary jaw ridges from which the last teeth had been extracted one year prior to the time of operation. The need for reduction of prominent alveolar ridges before successful prosthetic restorations could be constructed was obvious.

Physical and clinical examination of the patient revealed no data significant to the study. Reactions to Kahn and Wassermann tests were negative.

Records of the preoperative condition of the ridges were obtained. Roentgenographic studies were made before operation (Fig. 2) and at frequent intervals while the study was in progress. Plaster casts were made from impressions of the ridges to procure a record of the case in three dimensions (Fig. 3).

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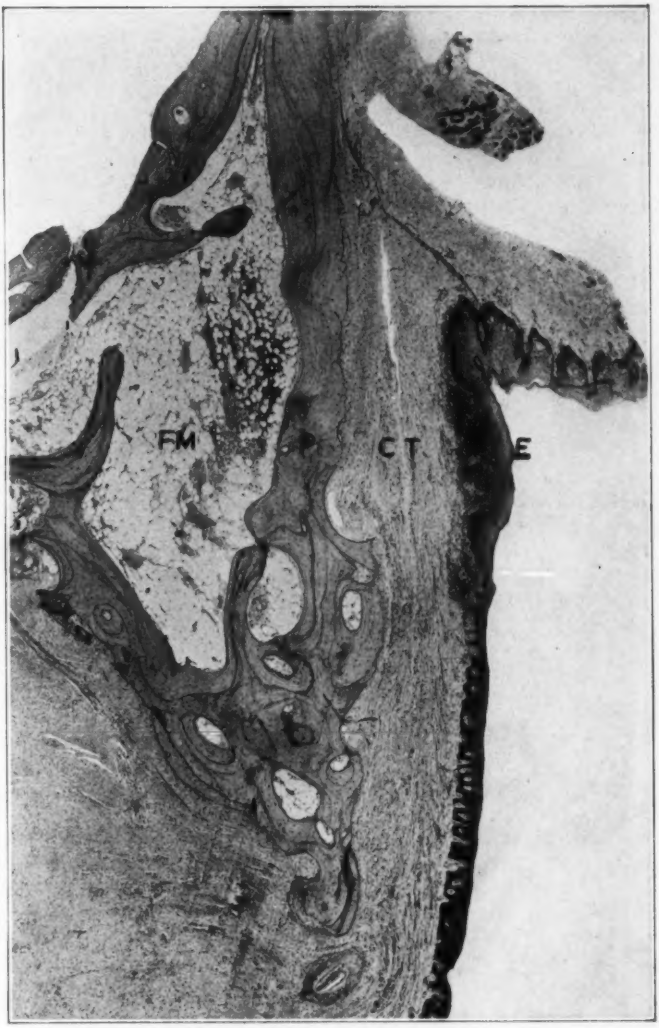

Fig. 6.—Biopsy section serving as a control in Case 1, taken from upper left tuberosity region, showing: E, epithelium; CT, connective tissue; P, periosteum and FM, fibrous marrow

CASE 2

A white woman, aged 37, who was a housewife, had edentulous maxillary and mandibular jaw ridges from which the last teeth had been extracted six months prior to the time of operation. The need for reduction of the prominent alveolar ridges before successful prosthetic restorations could be constructed was obvious.

Physical examination of the patient revealed no significant findings, and reactions to Kahn and Wassermann tests were negative. Clinical examination revealed no evidence of pathologic condition or other data pertaining to this study.

Records of the preoperative condition of the ridges were obtained. Plaster casts were made from impressions of the ridges to procure a record of the case in three dimensions. Roentgenograms were made before operation and at frequent intervals while the study was in progress, as in Case 1.

In both cases sections of tissue were removed from the jaw ridges at intervals ranging from two to fifty-three days. After the section was removed the tissue was placed immediately in Zenker's fluid, to which 5 cc. of glacial acetic acid had been added, and sent to the laboratory for fixation and preparation. Zenker's fluid is made by adding 5 parts of formaldehyde solution (full strength) to 95 parts of the stock solution of salts made up for Zenker's fluid.

CLINICAL OBSERVATIONS

Clinical observations in these cases were parallel to those made in cases of routine surgical removal of bone. If saliva is excluded from the region, coagulation usually takes place within ten minutes. Within a few hours after the operation, the clot is firmly established, reparative processes have started, red and white blood cells have passed into the injured tissues and fibroblasts are commencing their work of building new connective tissue. In two weeks the region of the wound becomes thoroughly organized and protected from external interference by a new layer of epithelium formed from the periphery of the wound. In this period, too, osteoblasts make their appearance in the tissues, and the work of calcification begins. The entrance of saliva into the wound and the use of high concentrations of adrenalin in the local anesthetic appear to hinder clot formation, thus exposing painful regions of denuded bone to the action of oral fluids. Treatment as usually applied to so-called dry sockets is successful in reducing this pain. A surgical pack also is helpful if left in position over these regions for three or four days (Fig. 4). One of the simplest preparations is zinc oxide and resin, equal parts, mixed with a liquid composed of equal parts of eugenol and liquid petrolatum or olive oil. This dressing is made into a stiff paste and applied to the wounds.

One of the outstanding clinical observations was the almost total absence of ecchymosis after the operation. Some extravasation of blood into the subcutaneous tissues was present, of course, but the usual purplish discolorations were absent. Hemorrhage did not present a particular problem and, when it occurred, was controlled in the usual manner or with a zinc oxide pack. In one case both maxillary sinuses were exposed but responded to usual procedures for closure. It is interesting to note that even these rather extensive surgical procedures in the first molar regions were not detrimental to the final shaping of the involved ridge. An exceptionally satisfactory result was obtained.

The tissue was still in the stage of adaptation after twenty-one days, but clinical experience has reinforced the viewpoint that the construction of dentures may be undertaken at this time without creating new injuries. One notable observation was the definite lowering of the buccal fold in the mouths of both patients after operation. This lowering was, perhaps, caused by the removal of excess bone and the subsequent diminished height of the ridge, but there was another factor which resulted in the constriction of the tissues and the lowering of the peripheral attachment. In all probability, this factor was the removal of the soft tissues to a considerable height (Fig. 5). No difference was observed in the results obtained with the sectional method

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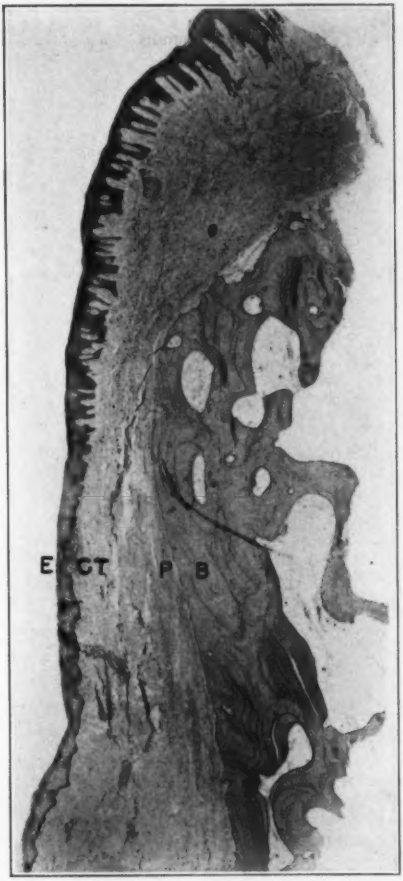

Fig. 7.—Biopsy section serving as a control in Case 1, taken from lower left bicuspid region of mandibular ridge, showing: E, epithelium; CT, connective tissue; P, periosteum and B, bone

as compared with those after complete alveolectomy. The sectional method, of course, is more tedious for the patient but may be valuable where greater shock from the more extensive surgical procedure is to be avoided.

STAGES OF HEALING

From the clinical and histologic observations made in the study it can be concluded that there are two main stages in the healing process of alveolar bone. The first is the immediate or reactive stage, seen immediately after injury to the bone. The second is the transformation stage which may persist throughout life.

The reactive stage is approximately three weeks in duration. It begins after

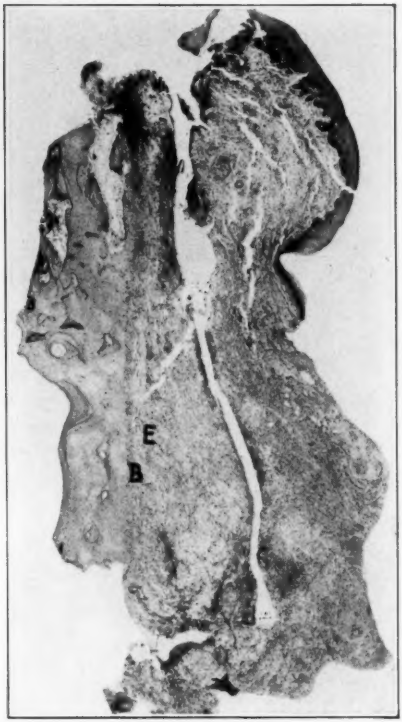

Fig. 8.—No union of the surgically severed parts is evident. Granulation is in progress and part of the bony surface is resorbed. Fatty marrow becomes fibrous marrow. E, elevated periosteum and B, blood clot organization

Fig. 10.—Photomicrographic appearance of upper left bicuspid region six days after elevation of periosteum. Apposition occurring at alveolar ridge resembles an early stage of osteoid bone. A, necrotic bone spicule and B, suture region

elevation of the periosteum from the bone and continues until apposition begins. When the transformation stage is reached the clinician may proceed with the construction of artificial dentures, as the tissues can bear the necessary pressures without undue pain. The transformation stage can be demonstrated histologically as well as clinically. It is characterized by the development of an osteoid tissue resembling bone. This tissue continues to develop until the new bone formation is completed. In the transformation stage, the reparative processes are confined to the connective tissue adjacent to the bone surface. Bone resorption becomes less marked after the initial period of three weeks (reactive stage). The process of building new bone now becomes most active and continues for an indefinite period, sometimes persisting throughout life.

HISTOLOGIC EVIDENCE

The following histopathologic findings were recorded for Case 1.

Figure 6 is a photomicrograph of a biopsy section representing the condition of the

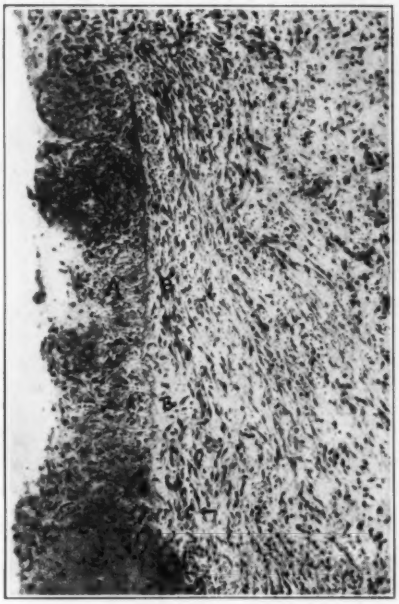

Fig. 9.—High magnification of Figure 8 showing: A, blood clot in state of organization; B, granulation tissue adjacent to blood clot and C, invasion of young connective tissue cells into the region

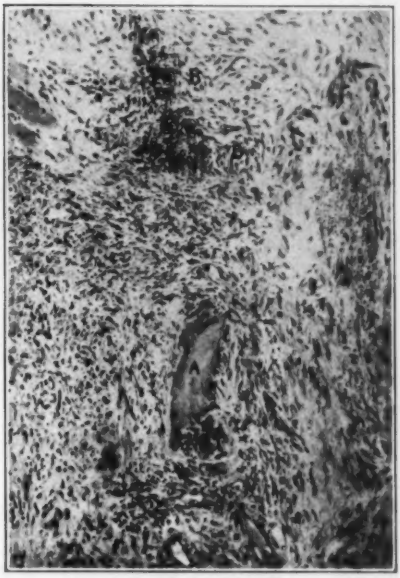

Fig. 11.—Higher magnification of A region in Figure 10. The wound has become largely organized and fibroblasts are invading the blood clots. Large numbers of red blood cells are lying free in the tissues. Edema is evident. A, necrotic bone spicule and B, remnant of blood clot

ridge in the rest stage which is the stage preceding any surgical interference. It is typical of the characteristics found in the alveolar ridge some time after the extraction of teeth. The section was obtained for use as a control for comparison with later sections and in determining when the traumatized tissues have resumed normal appearance.

In the specimen, the epithelium of the surface, the submucosa and the bone can be distinguished.

Figure 7 is another control section.

Figure 8 represents a section taken from the lower right cuspid region five days after elevation of the periosteum from the bone.

Figure 9, a high magnification of Figure 8, shows that the area adjacent to the incision is formed by fibrin.

In Figure 10 the surface of the bone shows apposition occurring on resting lines at the alveolar ridge. At the surface near the buccal fold new bone is formed on resorption lines. The bone marrow is a fibrous type and shows a few islands of fatty marrow. Slight apposition progresses along the bone surface toward the bone marrow. Organization of the wound is progressing rapidly and consists of fibroblasts invading the blood clot. Remnants of the fibrin network are present and large numbers of red blood corpuscles are lying free in the tissue. The bone marrow reacts to the injury by

Fig. 12.—Specimen taken from lower incisor region after thirteen days. Inflammatory reaction of subepithelial tissue has almost disappeared. Granulation tissue is confined to region adjacent to the bone surface. Bone marrow is still in the reactive stage. C, cementum particles

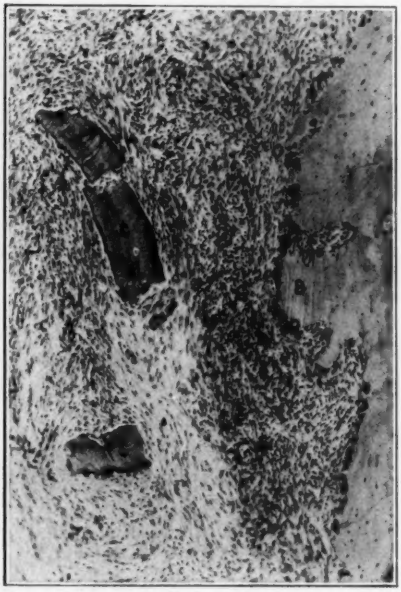

Fig. 13.—Higher magnification of C region in Figure 12 showing spicules of cementum surrounded by granulation tissue. The spicules are apparently remnants of a root, remaining after extraction. The entire surface of the bone, which is of a lamellated type, shows resorption in progress. Bone marrow is still in reactive stage, evidenced by edema in bone marrow spaces. B, bone; G, granulation tissue; C, cementum spicules, and O shows osteoclast cells

a production of fibrous bone marrow in the superficial bone marrow spaces. Edema is evident in this stage.

Figure 11 shows a higher magnification of Figure 10 taken from the area marked A.

A spicule of necrotic bone, seen in the connective tissue, is being cast off from the surface of the bone. Remnants of the blood clot in the form of fibrin are seen in an area below the necrotic bone spicule.

Figure 12 is a section of a specimen taken from the lower left incisor region thirteen days after operation. The entire surface of the bone shows resorption in progress. The bone is of a lamellated type. The bone marrow is still in a reactive stage, as evidenced by the edema in the bone marrow spaces.

Figure 13 is a higher magnification of Figure 12. The root fragments, represented by spicules, cannot be demonstrated on the roentgenograms, since they are microscopic in size. The surface of the bone is resorbed by osteoclast cells.

Figure 14 shows further change. The bone surface shows signs of new formation and can be seen best in the layer of the submucosa adjacent to the bone surface. Some necrosis is also seen.

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Fig. 14.—Photomicrograph of specimen from upper left cuspid region thirteen days after elevation of periosteum, showing no remnant of blood clot and apparent replacement of cellular elements by young connective tissue cells which form a broad layer adjacent to bone surface. A, young connective tissue cells and B, necrotic bone

Figure 15, a higher magnification of Figure 14, shows a concentric arrangement of the connective tissue cells around the epithelial peg.

Figure 16 shows further changes. There is a greater degree of bone formation on the surface of the bone than in previous sections, as seen in the area marked B. The new bone is being deposited on resorption lines. The bone facing the bone marrow spaces is in the aplastic stage.

Figure 17 is a higher magnification of Figure 16.

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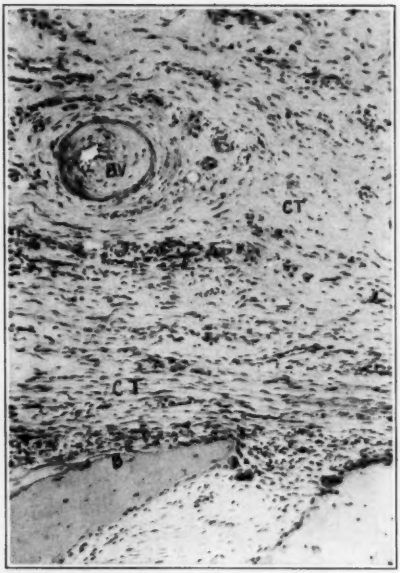

Fig. 15.—Higher magnification of A region in Figure 14 showing: B, new bone formation; CT, cellular infiltration in periosteal connective tissue and BV, a blood vessel. Young connective tissue cells form a broad layer next to the bone surface. There is slight cellular infiltration

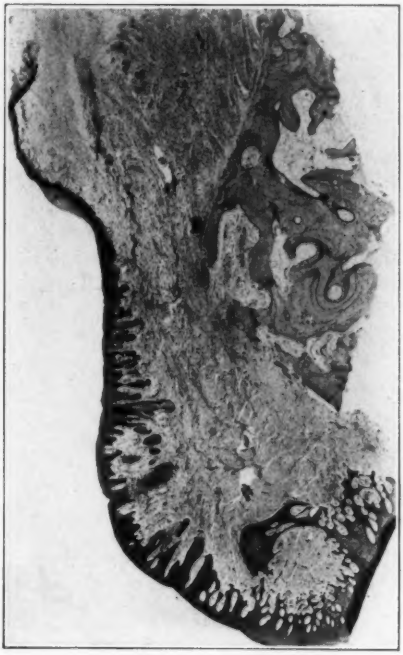

Fig. 16.—Further healing is in progress fifteen days after elevation of periosteum from upper left central incisor region

Figure 18 shows the wound assuming the condition seen before surgical interference.

Figure 19 shows the progress of transformation in the alveolar bone. The tissues are in the transformation stage, and the surface of the bone shows some resorption and apposition. Both superficial and deep bone marrow are fibrous.

Figure 20 shows still further changes. A few empty lacunae are seen at the alveolar ridge. This transformative stage will persist for some time and may even continue throughout life.

CONCLUSIONS

As was anticipated, many of the observations made in this study merely corroborated the results obtained by earlier investigators. Some of these results, however, were of merely academic interest because they had not been correlated with the coincidental clinical findings. In this study, the elevation of the periosteum was performed on patients available for observation of both biologic and clinical progress. Seven findings were made clinically and substantiated through photomicrographs of the tissues involved:

1. The entrance of saliva into the wound interferes with clot formation and may cause delayed healing of the periosteal wound.

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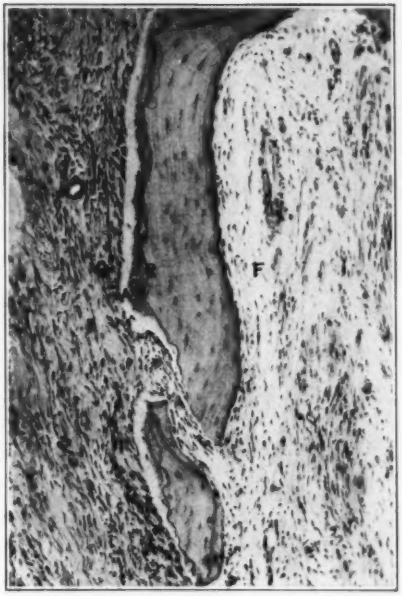

Fig. 17.—Higher magnification of B region in Figure 16 showing: G, granulation tissue; A, bone apposition; R, resorption line and F, fibrous bone marrow

Fig. 19.—Specimen from upper incisor region thirty-six days after periosteal elevation

2. The pain caused by elevation of the periosteum closely resembles that experienced in cases of so-called dry sockets and can be controlled in the same way. The role of the periosteum in the dry socket has not been studied, but in view of the observations in this study it might be worthy of further investigation.

3. A eugenol and zinc oxide pack is useful in controlling hemorrhage and in alleviating pain. There is also some evidence that such a pack promotes more rapid healing.

4. Entrance into the maxillary sinus does not influence the end result, because properly contoured ridges can be secured by careful closure of the sinus opening.

5. Three weeks after operation healing is sufficient to permit the construction of artificial dentures. From the clinical viewpoint, the tissues seem to be healed, and all inflammation has disappeared. From the biologic viewpoint, complete repair of the bone has not yet taken place, but the progress has been such that the construction of dentures will impose no new injuries.

6. The fact that reduction of the ridge alters the position of the buccal fold is of some clinical importance. The diminished height of the ridge after operation would account for some apparent lowering of the buccal attachment. However, it seems more realistic to conclude that the removal of the tissues over the bone to a considerable height causes a constriction of the tissues and a subsequent lowering of the peripheral attachment.

7. The partial alveolectomy, as opposed to the complete alveolectomy, is as

Fig. 18.—Specimen from lower right cuspid region twenty-two days after elevation of periosteum, showing epithelium and subepithelial tissues assuming normal condition. Resorption has ceased and there is some new bone formation

Fig. 20.—Photomicrograph of section taken from upper right tuberosity region fifty-three days after elevation of periosteum, showing complete healing. Resorption is seen on the bone surface throughout the section. Apposition is seen in one circumscribed region. Tissues are still in stage of adaptation

satisfactory from the standpoint of ridge contour and healing. This type of operation, in the light of this study, might well be employed for cases in which the reduction to be made is of considerable proportion or if the patient's general physical condition does not permit the more drastic procedure of the complete alveolectomy.

In all bone growth there is an alternation of formation, destruction and regeneration. This process continues as long as the bone functions as an organ of support. Repair and regeneration of the bone is accomplished largely through the agency of the periosteum, and this study confirms the importance of this structure in the healing of wounds made in the surgical reduction of jaw ridges.

From the clinical and histologic observations made in the study it can be concluded that there are two main stages in the healing process of alveolar bone. The first is the immediate or reactive stage which is seen immediately after injury to the bone. The second is the transformation stage, which follows the reactive stage and which may persist throughout life.

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SUMMARY

A study was made to determine the effect of elevating the periosteum from bone, a procedure essential to the performance of the alveolectomy. Since progressive effects of the elevation could not be studied properly in material taken at autopsy, tissue was taken from two patients at intervals ranging from two to fifty-three days. Histologic and clinical observations were made and correlated at each of these time intervals.

The results of the study in terms of clinical significance were: saliva interferes with wound healing; pain after elevation of the periosteum resembles that of a dry socket; a surgical pack is useful in controlling ensuing hemorrhage; exposure of the maxillary sinuses need not produce an undesirable end result; a period of three weeks after alveolectomy is sufficient before the construction of dentures; ridge reduction alters, both actually and apparently, the position of the buccal fold, and the partial alveolectomy is a satisfactory operation under certain, well chosen conditions.—*4013 Milwaukee Avenue.*

AMERICAN BOARD OF ORAL SURGERY

Examinations for certification by the American Board of Oral Surgery will be held at Boston, July 29 and 30, 1947, and at Chicago, November 7 and 8, 1947.

A complete outline of the requirements for certification by the American Board of Oral Surgery, as well as general standards that have been set up for all specialists in dentistry by the Council on Dental Education of the American Dental Association, will be found in the April 15, 1947, issue of the Journal of the American Dental Association.

Requests for application forms or additional information should be addressed to Dr. Leslie M. FitzGerald, Secretary, 718 Roshek Building, Dubuque, Iowa.

PENTOTHAL SODIUM ANESTHESIA BY WAY OF THE STERNUM

Howard E. Kessler, D.D.S., San Diego, Calif.*

Cases will be found in which the patient has no visible or palpable veins, as is the situation in those persons who are extremely obese. In these cases, Pentothal sodium may be injected into the marrow of the sternum.

A point is located about halfway down the blade of the sternum. Enough procaine to raise a small wheal is inserted under the skin. A size 15 needle is used and is inserted at a 45-degree angle with the bevel down (Fig. 1). When the needle has penetrated the outer cortical plate, it is not difficult to tell by the feel and freedom of the needle that it has entered the marrow of the bone. Since the bevel is down, the probability of continuing through the inner aspect of the cortical plate is not likely, because the needle will slide forward along the bone. As soon as the needle is felt against the inner cortical plate, it is given a quarter turn so that the solution will not run against the bony wall.

The needle should be inserted with a stilet in place so that the needle will not be clogged with bone.

After the needle has been inserted in the bone, the stilet is removed and a syringe is attached. The syringe is aspirated, to receive some marrow, in order to assure that the needle is in the bone marrow.

At this point, administration of Pentothal Sodium can be begun or the premedication can be injected into the sternum.

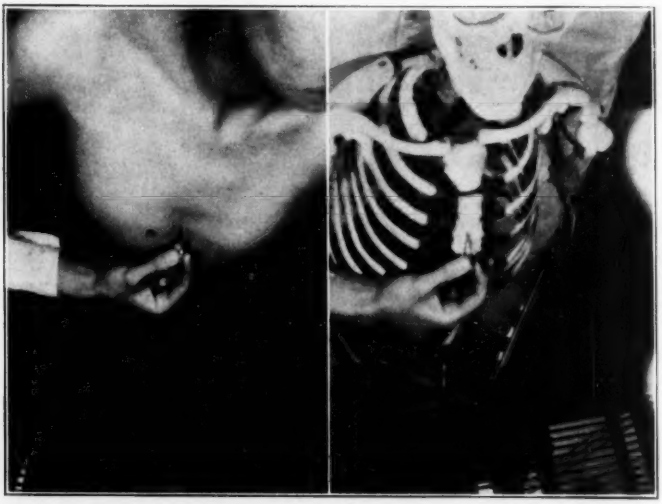

Fig. 1.—Demonstration of the technic of needle insertion into the body and into the visceral skeleton

*Resident in anesthesia and oral surgery, San Diego County General Hospital, San Diego, Calif.

REPORT OF CASE

History.—An obese man, aged 60, came to the hospital receiving room with a swelling of the lower left side of the mandible.

Examination.—Dental roentgenograms revealed that the lower left first and second molars were abscessed and that the lower left cuspid and first bicuspid were broken off at the gum line.

The patient's heart sounds were normal and the blood pressure was 138 systolic, 88 diastolic and 80 pulse. No veins were visible or palpable. It was decided to administer Pentothal Sodium by sternal puncture.

Premedication.—The needle was inserted into the body of the sternum, as previously described. As soon as the needle was clear and bone marrow could be aspirated, a 5 cc. syringe containing the morphine sulfate 1/6 grain and Scopolamine 1/100 grain was attached to the needle. The premedication was injected.

After an interval of approximately three minutes (we usually allow five minutes for intravenous premedication to begin to take effect), during which time we removed the 5 cc. premedication syringe and substituted a 10 cc. syringe containing a 2½ per cent solution of Pentothal Sodium, we were ready to inject the anesthetic.

Anesthesia.—The 10 cc. of Pentothal Sodium was injected very slowly. The patient's jaw became relaxed and movement of the eyeball was slight. The drip method was then started, with a 1 per cent solution, and the molars, the cuspid and the first bicuspid roots were extracted.

A total of 500 mg. of a 1 per cent solution of Pentothal Sodium was administered in addition to 250 mg. of a 2½ per cent solution. Therefore, a total of 750 mg. of Pentothal Sodium was given by sternum.

Outcome.—Intramuscular injection of 20,000 units of penicillin was administered every three hours during the patient's stay in the hospital. Recovery was uneventful.

CONCLUSION

Administration of Pentothal Sodium by sternum seems to be so simple that many of us might be tempted to make routine use of this method of inducing anesthesia. However, the attending dangers are sufficient (entry into the mediastinum, bone infection) to dictate our limiting use of the method to those patients without visible or palpable veins and to those whose veins are extremely sclerotic.—*North End of Front Street.*

AMERICAN SOCIETY OF ORAL SURGEONS

The twenty-ninth annual meeting of the American Society of Oral Surgeons will be held at the Copley Plaza Hotel in Boston, Thursday, Friday and Saturday, July 31, August 1 and 2, 1947.

PRELIMINARY REPORT ON THE USE OF TANTALUM IN MAXILLOFACIAL AND ORAL SURGERY

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For hundreds of years surgeons have been experimenting with extraneous materials in the repair and reconstruction of various tissues, especially of defects resulting from the loss of some part of the supporting framework. Several thousand reports of the use of metals have been recorded since the year 1565, when Petronius devised a gold plate to repair a cleft palate. Since then gold, silver, lead, tin, aluminum, magnesium, brass, copper, iron, steel and many other metals, as well as ivory, paraffin and celluloid, have been tried at one time or another, and for the most part are now considered unsafe. Only in the last few years, with the development of fairly nonirritating alloys, have metallic substances met with some favor. Their use has been limited largely to the field of orthopedic surgery where they are used for internal fixation of fractures. The alloy which has been used most successfully thus far for this purpose is vitallium, an alloy of chromium, cobalt and molybdenum. However, it is not tolerated by the body in all instances, and it has been reported that it is capable of liberating a soluble and highly toxic chromium salt into the tissues. Also, the metal cannot be machined; every appliance must be cast or ground, necessitating a large supply of appliances in various sizes, shapes and lengths. It is extremely hard and impossible to shape at the time of operation if the size and contour of the cast metal form does not conform accurately to the defect.

The disappointing results from the use of metal have been caused by the electrochemical phenomenon known as corrosion, a process whereby soluble and more or less toxic salts are introduced into the body fluids. Since corrosion is an oxidation process, any metal immersed in living tissue is subjected to a severe test because of the variety of oxidizing agents, notably oxygen, that is continuously circulating about it. Unfortunately, even quite inert metals may form soluble complex compounds which are sufficiently stable, so that in time a toxic concentration of these compounds can be built up. The only hope of preventing corrosion lies, therefore, in using a metal which corrodes at a negligible rate. It would appear that tantalum fulfills this requirement.

HISTORY

Tantalum was discovered in 1802, by a Swedish chemist, and received its name from the discoverer because of the tantalization he endured in trying to isolate it from its compounds. It is the seventy-third element of the periodic table and has the advantage of being a single elementary substance that is highly resistant to corrosion. The ore from which the metal is procured was found originally in Australia, but more recently deposits have been found in the Black Hills of South Dakota and other parts of the United States. During the war it held one of the highest transportation priorities.

Read at the twenty-eighth annual meeting of the American Society of Oral Surgeons, Miami Beach, Fla., October, 1946.

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PHYSICAL AND CHEMICAL PROPERTIES

Tantalum has a characteristic bluish-gray, metallic color. It has a density of 16.6 which is about twice that of steel. The strength, toughness and workability of unannealed tantalum are comparable to these attributes in cold rolled steel. Of importance to the surgeon is the fact that tantalum becomes work-hardened or fatigued at a much slower rate than most other metals. It compares with glass in its resistance to body chemistry. It is used in chemical industry where great resistance to corrosion and chemical attack is required. It is inert to weak alkalies and dilute solutions of strong alkalies. It is completely unaffected by hydrochloric acid, aqua regia (nitrohydrochloric acid), organic acids, salts, alcohols, ketones, aldehydes and esters. It is totally inert to wet or dry chlorine, bromine or iodine at temperatures below 150 C. The only acids which will attack the metal are hydrofluoric, sulfuric and phosphoric, the latter two only in concentrated solutions at high temperatures.

It has been estimated that the life of a piece of tantalum, based on 50 per cent loss by corrosion in concentrated phosphoric acid at a temperature of 145 C., would be 870 years.[1] In concentrated sulfuric acid at a temperature of 147 C., tantalum's life expectancy, based on 50 per cent loss by corrosion, is estimated to be 955 years.

The ductility of tantalum is comparable to that of nickel because of its ability to be drawn, stamped or formed into complicated shapes.[2] It may be machined with ordinary steel tools. Carbon tetrachloride is used as a cutting compound. It welds perfectly to itself and certain other metals by the electric spot method and others. It is capable of being hardened through a wide range without losing any resistance to chemical attack.

SURGICAL USES

Pudenz[3] and other investigators report that tantalum placed in contact with brain tissue produces a minimal proliferation of connective tissue. Observation of this minimal reaction in the meninges led Pudenz to utilize tantalum clips in preference to silver clips after observing that the latter produced an intense inflammatory reaction with eventual fibrous encapsulation, in contrast to the negligible reaction provoked by the tantalum clips. As a result of these findings, tantalum clips have replaced silver clips in the neurologic service of the United States Army Medical Corps.

In 1939, Grant and Norcross[4] reviewed the methods used for repairing cranial defects. A critical review of their excellent work clearly demonstrated that there existed no adequate method for repairing such defects at that time. Since then the literature is so replete with reports of the use of tantalum for cranioplasties that it must be considered as universally employed for this purpose.

Spurling[5] reported the use of fine tantalum suture material and tantalum foil for the repair of peripheral nerves. After the suturing of the nerve trunk was completed, a cuff of tantalum foil was wrapped snugly around the nerve and held in place with

1. Burke, G. L., Corrosion of Metals in Tissues; An Introduction to Tantalum. *J. Canad. M. A.* 43:125 (August) 1940.
2. Olson, C. T., Place of Tantalum in Surgery. *Indust. Med.* 13:917 (November) 1944.
3. Pudenz, R. H., Repair of Cranial Defects with Tantalum. *J.A.M.A.* 121:478 (February 13) 1943.
4. Grant, F. C., and Norcross, N. C., Repair of Cranial Defects by Cranioplasty. *Ann. Surg.* 110:488 (October) 1939.
5. Spurling, R. G., Use of Tantalum Wire and Foil in Repair of Peripheral Nerves. *Surg. Clinics North America* 23:1491 (December) 1943.

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circular ties of fine tantalum wire. Spurling summarized that gross and histologic evidence indicated that tantalum is inert to human tissues, and that scarring and fixation of repaired nerves can be reduced to a minimum by the judicious use of tantalum foil.

Burch and Carney,[6] of Vanderbilt University, first used tantalum wire, screws and fixation plates in fractures of the tibia, femur, fibula, humerus, patella and mandible. The patients show no reaction from the metal five or more years after operation.

Kiskadden[7] reports that tantalum wire "is superior to either cotton or silk when used beneath split skin grafts. The reason lies in the complete lack of tissue reaction." This report is based on an experience with 70 cases.

Schuessler[8] reports the use of tantalum wire for the correction of facial paralysis, and describes a technic for passing the wire from the temporal area to the affected muscles around the mouth. The ends of the wires are anchored to the small cuffs of sheet tantalum circumscribing a small bundle of muscle fibers. This procedure was devised to prevent the fine wire from cutting through the tissues.

Tantalum oxide powder, type 400, has also been reported as an excellent dusting powder, being extremely soothing to areas of the skin which have been chafed or irritated.[9] The same author reports enthusiastically of its use as a dressing for certain types of traumatic injuries and burns.

In addition to these enumerated uses, tantalum has been employed by ophthalmologists who have devised special technics whereby the muscles of the eye may be attached to tantalum implants. In general surgery tantalum sutures have been used to close abdominal wounds, and tantalum gauze has been used to reinforce the abdominal wall in recurrent and expected recurrent hernia.

In our clinic, tantalum in one form or another has been used in 25 different patients for a rather wide diversification of purposes. In 11 cases, the wire, .025 of an inch in diameter, has been used for open reduction of fractured mandibles or for retaining bone grafts. In no case has the removal of the wire been necessary because of lack of tolerance by the tissues. X-ray examinations at various intervals after the operation have shown no decrease in density nor rarefaction of the bone adjacent to the wires. Instead, osteogenesis around the wires has been demonstrated repeatedly.

Tantalum wool has been used in 5 cases and has been found useful in creating and restoring facial contour and symmetry. The wool is fabricated from fine suture material, .007 inches in diameter, and formed in loosely woven balls of different sizes. Although loosely woven, the matting must be sufficiently rigid to maintain the desired facial contour after being placed in position. It is capable of being fluffed into various sizes and shapes.

After suitable preparation of the skin, the extent of the defect is outlined on the face with a sharp, sterile indelible pencil. The recipient region is prepared through an incision made at right angles to the surface of the skin and parallel with the lines of normal tension on the skin. On the lower part of the face this incision is made

6. Burch, J. C., and Carney, H. M., Experimental Study with Tantalum. *Proc. Soc. Exper. Biol. & Med.* 51:147 (October) 1942.

7. Kiskadden, W. S., Tantalum in War Surgery. *Am. Acad. Orthoped. Surg.* Lecture, 1944, p. 245.

8 Schuessler, W. W., New Technique for Repair of Facial Paralysis with Tantalum Wire. *Surgery.* 15:656 (April) 1944.

9. Olson, C. T., Preliminary Report on Use of Tantalum Oxide, Type 400. *Indust. Med.* 14:949 (December) 1945.

under the shadow line of the mandible. The defect is undermined in the marked-out region, keeping just outside the periosteum. After the bleeding has been well controlled, an amount of the wool sufficient for the desired correction is placed lightly in the prepared bed and molded to the desired contour with the fingers. The wound is closed tightly and a dressing of moderate pressure is applied.

In none of the 5 cases was there the serosanguineous exudate that occasionally resulted from our use of preserved cartilage for the correction of similar defects. The loosely woven wool serves only as a skeleton through which fibrous tissue repair occurs.

One disadvantage possessed by metals and not shared by other materials is their radiopacity. If roentgenograms of the teeth or jaws in the region of this metallic substance are required at some future date, the radiopaque material is a severe handicap to adequate roentgenographic examination. However, the simplicity of the procedure involving the use of tantalum, the negligible postoperative discomfort to the patient, the elimination of the additional operation to procure an autogenous transplant and the final result would seem to more than compensate for this disadvantage.

Facial paralysis in one patient was corrected by the use of sutures of fine wire, .007 of an inch in diameter, anchored in the temporal region and attached to the affected muscles around the mouth. The wires were attached both above and below to small cuffs of sheet tantalum .0025 of an inch thick. A hole was made in either end of the cuff through which the wire was passed and anchored after the cuff had been placed around a small bundle of fascia and muscle. Three wires were used, all anchored to a single incision over the temporal region, while one was attached to the muscle of the upper lip, one to the corner of the mouth and one to the lower lip. The immediate result was satisfactory. After several months the support to the corner of the mouth gave way. It is believed that the wire broke or in some way became detached from the cuff. A possible refinement of this procedure may be found in the use of tantalum gauze for anchoring the wire.

Tantalum sheet, .020 of an inch thick, has been used for splinting the segments of mandible for 4 patients after resection for malignant growth, and for 1 patient after the loss of the horizontal portion of the mandible by gunshot injury. The splint is preformed whenever the necessity for its use is anticipated. Measurements for construction of the splint are procured from the roentgenographic image. After the splint is fashioned to the desired shape, the edges are smoothed and rounded to minimize irritation.

These splints are intended only to retain the bone segments in their proper anatomic position until and if bone grafting becomes advisable. In the interim the segments are stabilized, and the mandible operates as a unit with varying degrees of function. Facial contour is preserved, and the usual caricature-like physiognomy is avoided until more definitive treatment is instituted.

Exposure of the metal to the mouth does not seem to interfere with its tolerance by the tissues. In fact, it is quite amazing how the soft tissues, under certain conditions, will build up around this foreign body. One case in point was that of a mandibular resection anterior to the mental foramen and above the mandibular foramen combined with extensive electrosurgical destruction of a malignant intra-

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oral lesion. The splint was exposed the full distance of the intra-oral defect. In due time it was covered entirely with mucous membrane.

In this connection the neurologic surgeons have noted that tantalum may remain in the tissues in the presence of infection without the production of a foreign body tissue reaction.

A thinner sheet, .010 of an inch thick, was used for 2 additional patients, one of whom required closure of an antral-oral opening that had resisted five attempted closures and another requiring correction of a badly deformed nostril resulting from a cleft of the lip.

Zar Reader, in an unpublished paper, reports his findings in the use of tantalum oxide, type 400, in 50 consecutive patients after the electrosurgical treatment of periodontoclasia. For comparative purposes, only one jaw was operated on at a time. The powder was used on half the region operated on, while the remaining half had only the usual dressing of zinc oxide and eugenol with cotton fibers added.

At the completion of the operation the field was isolated with cotton rolls and dried. Tantalum oxide was sprayed with an atomizer on half the region operated on until a dry film of the powder was formed. The usual dressing of zinc oxide and eugenol was then applied over the entire region.

The purposes of this experiment were to determine whether there was a measurable increase in the rate of healing and if the region was made more comfortable by the use of the powder. In the 50 controlled experiments there was no apparent benefit from the standpoint of either the rate of healing or degree of comfort.

REPORT OF CASES

CASE 1

A woman, aged 51, entered the hospital on May 16, 1945, with an ununited fracture of the left side of the mandible. Both upper and lower jaws were edentulous distal to the cuspids. The remaining teeth were so loose that dentures were imperative.

History.—In 1916, the patient had an impacted lower left third molar removed. Osteomyelitis of the left side of the mandible developed and persisted for several years. Nine operations for drainage and sequestrectomy were performed, which resulted in an ununited fracture in the molar region. The osteomyelitic infection had been quiescent since 1937.

Examinations.—General physical examination showed no abnormalities except mild hypertension, 150/105, and signs of occasional episodes of eczema. The results of routine laboratory examinations were within normal limits. There was a pseudarthrosis in the molar region of the left side of the mandible (Fig. 1, left) with sufficient motion to make the wearing of a lower denture impossible. The submandibular area on the left side was badly scarred from the former operations.

Operation.—On the day after admission, the patient was anesthetized with nitrous oxide and ether vapor and a graft, employing the full thickness of a section of the patient's eighth rib, was used to bridge the bone defect. After the recipient bone ends were suitably shaped, the graft was held in place with .025 gage tantalum wires passed through either end of the graft and the mandible and twisted snugly.

Course.—Healing was uneventful except for considerable pain in the donor region. This complaint is usual in cases where the continuity of a rib is broken completely. X-ray examination (Fig. 1, right) showed no reaction around the wires one year later. Clinically the jaw was healed solidly and the tantalum wires have shown no tendency to tissue reaction.

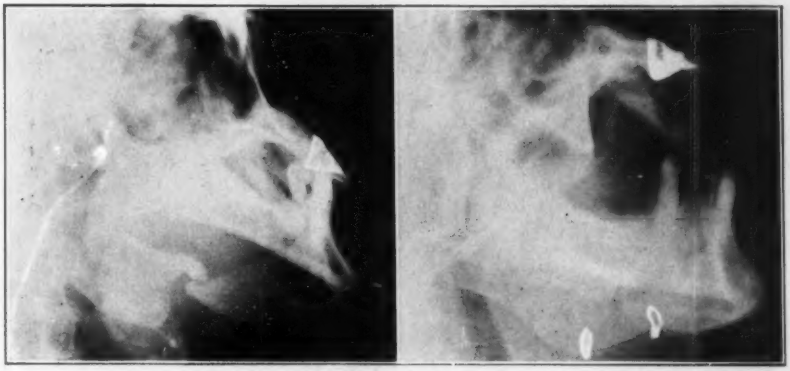

Fig. 1.—Left: Pseudarthrosis of left side of mandible caused by long-standing osteomyelitic infection which had been quiescent for seven years prior to placement of bone graft. Right: Appearance of bone structure around tantalum wires one year after bone graft was placed. Note entire absence of bone rarefaction around wires

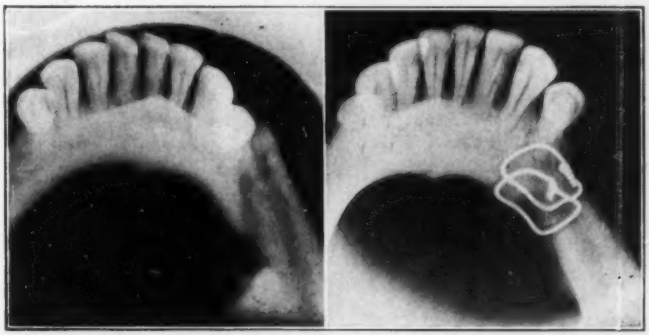

Fig. 2.—Left: Appearance of malunion of mandible after five months' osteogenesis. Right: Appearance of bone structure around wires after five months. There is no evidence of tissue reaction around the wires

CASE 2

A woman, aged 40, was referred to me on August 10, 1946, with a malunion of the body of the mandible on the left side.

History.—In March, 1946, the patient was in an automobile accident and sustained severe injuries to the face and skull, and fracture of the clavicle, the third rib and the pelvis. She was unconscious for two weeks. Owing to the patient's critical condition, with particular reference to the intracranial injuries, very little could be done in the way of correcting the fractured mandible.

Examinations.—General physical examination disclosed nothing abnormal except varicosities of the lower extremities and an ununited fracture of the left clavicle with wide separation of the fragments. However, the patient had excellent function of the left shoulder and relatively little discomfort. Findings in routine laboratory examinations were negative. Oral examination showed a palpable irregularity of the left side of the mandible in the bicuspid region with solid

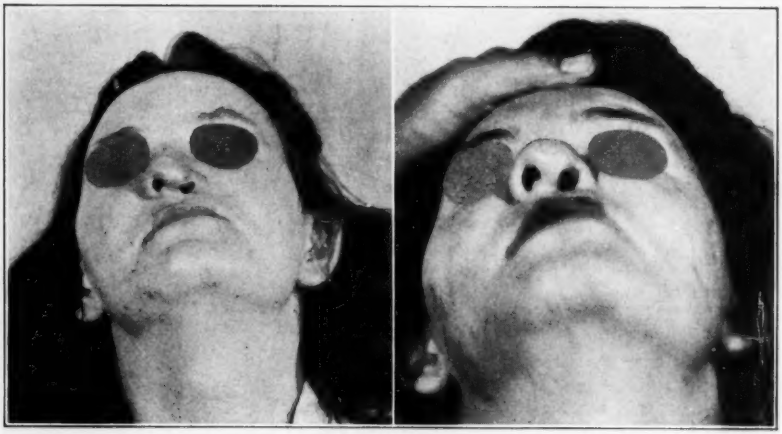

Fig. 3.—Left: Characteristic deformity of nostril caused by improperly handled operation for single cleft lip. Right: Appearance of nostril after being shaped with tantalum implant. The redundant mucous lining is still to be excised

union of the bone segments. The chin deviated to the left and there was a noticeable facial deformity and a distinct malocclusion. The lower lip was not anesthetic. X-ray examination showed malalinement of the fragments with considerable osteogenesis (Fig. 2, left).

Operation.—Through a submandibular incision, the site of the old fracture was exposed and the bone segments were separated with mallet and chisel. The eburnated bone ends were freshened to bleeding cancellous bone. The bones were held in correct approximation while two drill holes were placed through each segment with a hand drill. Tantalum wire, .025 of an inch in diameter, was placed through the opposite drill holes and twisted until the bone segments were held tightly together. During the surgical procedure an oral opening about 1 cm. in length, directly over the fracture line, inadvertently occurred. The extra-oral wound was closed tightly.

Course.—Healing was uneventful. The wires have been perfectly tolerated by the tissues (Fig. 2, right).

CASE 3

A white girl, aged 21, came to the oral surgery clinic in August, 1945, for further repair of her cleft lip and palate.

History.—Repair of the deformity had been attempted first when the patient was 4 years old. At that time both the lip and palate had been operated on. When the patient was 10 years old, a piece of protruding tissue had been removed from the lip to effect a better cosmetic result.

Examination.—The findings in general physical examination were negative. For the most part the cleft lip and palate had been repaired poorly. There was unnecessary and unsightly scarring of the lip, and the nostril on the affected side was flat and deflected. The palate had largely sloughed away, and there was insufficient tissue for repair.

One of the most common and difficult problems in surgery for cleft lip is the flat ala and distorted nostril (Fig. 3, left). The deformity is made more conspicuous by the fact that the affected nostril is horizontal rather than vertical. The difficulty of correcting this deformity is attested to by the large number of proposed procedures for its treatment in textbooks and periodicals.

Fig. 4.—Left: Lack of development of symphysis caused by bilateral bony ankylosis of temporomandibular joints. Right: After implantation of tantalum wool the wound has been closed and the chin has been molded to desired shape by finger pressure

Operation.—The patient was given a local anesthetic, and an incision was made at the mucocutaneous junction across the upper part of the nostril from the ala to the columella. Cutting beneath the greater alar cartilage to the borders of the defect, I undermined the skin through this incision. A small piece of tantalum plate, .015 of an inch thick, was shaped and the edges were smoothed and rounded. The plate was bent and fitted until, when placed in the surgical defect, the nostril corresponded in shape and direction to the opposite one. The incision was closed with interrupted nylon sutures.

Course.—The implant has been well tolerated and there has been no evidence of soft tissue reaction. The symmetry of the nose and nostril has been greatly improved (Fig. 3, right).

CASE 4

A girl, aged 14, entered the hospital on March 18, 1943, with bilateral ankylosis of the temporomandibular joints.

History.—When 6 years old, she fell from a considerable height and received a severe blow on the chin. There was progressive loss of mandibular function over a period of fourteen months until there was entire loss of motion. The parents had noticed a concomitant lack of development of the chin (Fig. 4, left). Three years prior to the patient's admission an unsuccessful attempt had been made to force her jaws open under general anesthesia.

Examinations.—General physical examination showed no abnormalities except scoliosis in the left lumbar region and a functional systolic heart murmur. Oral examination revealed bilateral bony ankylosis of the temporomandibular joints with the characteristic lack of development of the mandible, especially at the symphysis. There was a transverse scar on the point of the chin from the original accident.

Operation.—Arthroplasty of the temporomandibular joint on the right side was performed on March 20, 1943, and one week later a similar procedure was carried out on the left side. The patient was discharged from the hospital on April 4, 1943, with satisfactory function of

Fig. 5.—Improvement in profile resulting from tantalum implant over symphysis

the jaw. The parents were advised that the underdeveloped chin could be repaired if and when it was requested.

Second Operation.—The patient was readmitted to the hospital on September 9, 1945, for reconstruction of the chin. The teeth were in acceptable occlusion but the abnormal profile, resulting from lack of symphysial development, had caused the patient to be extremely sensitive and she had refused to return to school. The patient was anesthetized with ethylene gas and ether vapor. Tantalum wool, previously made up from suture material .007 inches in diameter, was implanted in a bed made by dissecting the soft tissues from the periosteum over the region of the chin. The incision was kept well under the shadowline of the chin, and good hemostasis was procured before the wool was inserted. After the wound was closed the chin was shaped by finger pressure (Fig. 4, right).

Course.—There was no discharge from the wound. The sutures were removed on the fourth day after operation and the patient was discharged on the next day. Follow-up examinations have been made for a year and there have been no symptoms referable to the implant (Fig. 5).

CASE 5

A girl, aged 19, was seen in the outpatient department in December, 1941, complaining of inability to open her mouth, and a marked facial deformity.

History.—The patient was almost totally deaf, and her mother reported that the child had scarlet fever when 4 years old, followed three months later by diphtheria. After these illnesses there was a gradual decrease of jaw function with the development of facial deformity.

Examinations.—General physical examination revealed a well nourished, well developed young woman with bilateral otitis media and mastoiditis.

Fig. 6.—Characteristic deformity of mandible caused by unilateral ankylosis. On the affected side the face is full and round, while the unaffected side is flat and deformed

Oral examination showed an oral opening of 1½ cm. No movement of the temporomandibular joint on the right side could be elicited by palpation. The symphysis was underdeveloped and there was the characteristic maldevelopment of the mandible that occurs in unilateral ankylosis, that is, the face on the ankylosed side was normal in appearance, while the unaffected side was flat and deformed (Fig. 6). When the patient attempted to open her mouth the mandible deviated to the affected side.

X-ray examination showed complete effacement of the structures of the temporomandibular joint on the right side with considerable bone production throughout the region.

Operations.—The patient was given a general anesthetic, and arthroplasty of the temporomandibular joint on the right side was performed on January 24, 1942. Convalescence was uneventful, and the patient was discharged on the ninth day after operation.

On February 14, 1945, she was readmitted for correction of the mandibular deformity. Several balls of tantalum wool composed of the suture material, .007 inches in diameter, were made up in different sizes. The material was wound loosely, with sufficient rigidity to maintain its form but still capable of being fluffed and moulded in any shape. The ends of the wire were fastened together and buried in the substance of the ball.

The defect was outlined on the skin with a sterile, indelible pencil. The patient was given a local anesthetic of a 1 per cent solution of procaine, and an incision was made under the symphysis and carried a short distance to the affected side. Through this incision the tissues were loosened from the periosteum in the region designated by the pencil mark on the skin. Hemostasis was effected, and a sufficient amount of the wool was inserted to build out the depressed region to the desired contour. The wound was closed tightly, and more definitive

Fig. 7.—Comparative photographs of chin before and after implantation of tantalum wool

configuration was obtained by moulding the implant with the fingers and palms of the hands before applying the dressing.

Course.—Healing was uneventful, there was no discharge from the wound and there have been no symptoms referable to the implant over a period of two years of observation (Fig. 7).

CASE 6

A man, aged 60, was first seen in the outpatient department on April 10, 1945. His complaint was pain and soreness of one year's duration in the lower jaw on the right side. For two weeks before he was seen the discomfort was of such intensity that he was unable to sleep.

History.—Two years previously he had a lesion removed from the right lateral border of the tongue, reported, after microscopic examination, to be leukoplakia. The bone of the lower jaw on the right side had been "scraped," but no microscopic report from this procedure was available.

Examinations.—General physical examination revealed arteriosclerotic heart disease with symptomatic myocardial insufficiency and diabetes mellitus for which the patient was under treatment. His reaction to the Kline-Young test for syphilis was negative. The patient's blood pressure was 158/94.

Oral examination disclosed edentulous jaws. The mucoperiosteum covering the ridge of the mandible in the right bicuspid and molar region was ulcerative. The lesion was about 1 inch long on the crest of the ridge and extended out into the tissue of the cheek and to the floor of the mouth. A specimen incorporating a portion of the lesion and adjacent normal tissue was removed for biopsy, and stereoscopic roentgenograms of the mandible in the right lateral position were made. Pathologic diagnosis was squamous cell carcinoma, type 2. X-ray examination showed destruction of the cortical layer of bone in the molar and bicuspid region with disturbed bone architecture beneath it that was indefinite in extent.

Operation.—On April 20, 1945, the patient was anesthetized with a 4 per cent solution of procaine and the malignant growth was thoroughly fulgerized. The mucous membrane, periosteum and bone within a considerable distance of the lesion were destroyed. The region of bone invaded by the neoplasm extended down to the mandibular canal, which made resection of the mandible at either end of the canal necessary. The mandible was exposed extraorally from the symphysis to the angle and resected with a Gigli saw anterior to the mental foramen and above the mandibular foramen.

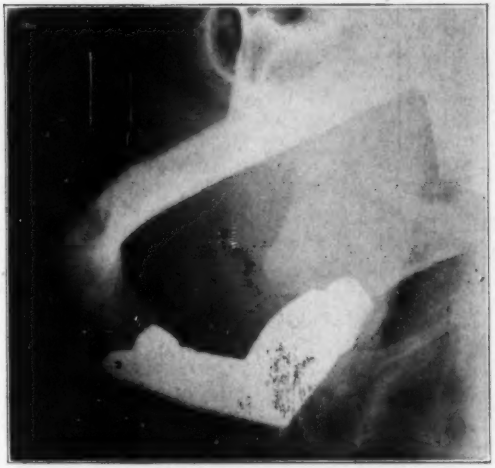

Fig. 8.—Tantalum plate, .015 inch thick, fashioned into a splint and wired to bone segments after resection. Facial contour is preserved and bone segments are maintained in normal position for subsequent bone graft

A piece of tantalum plate, .015 inch thick, as used by neurosurgeons for the plastic repair of skulls, was hastily and none too meticulously fashioned and wired to the bone ends with stainless steel wire (Fig. 8). This plate was intended only as a splint to preserve facial contour and prevent collapse of the bone segments until and if a bone graft could be inserted. Intra-orally the tantalum splint was visible for the full extent of the fulgerized region.

Course.—The patient was discharged from the hospital eight days later. The external wound had healed solidly, and intra-oral tissue was regenerating at a normal rate around the tantalum splint. Healing of the intra-oral wound continued until the tantalum splint was covered entirely with normal appearing tissue.

After remaining in place with absolute comfort to the patient for nine months, the splint broke at the angle where it had been weakened during the fashioning procedure. There was no discoloration of the metal when it was removed and no macroscopic evidence of reaction of the tissue. Of equal significance was the fact that new bone had regenerated at the points where the tantalum was attached to the segments of mandible, so that the wires were completely covered and were not located until considerable bone had been removed.

CASE 7

A woman, aged 29, was admitted to the hospital May 25, 1945, requesting facial reconstruction.

History.—The patient sustained a fall when she was 5 years old and struck the right side of her mandible. There was a slow but progressive enlargement of the jaw after this injury. Five operations were performed over a period of twenty-three years, and in March, 1944, the entire right half of the mandible was resected. A pathologist's report of ossifying fibroma was obtained from the institution where the resection was performed.

Examinations.—General physical examination revealed no abnormalities, and the findings of routine laboratory examinations of blood and urine were within normal limits.

Fig. 9.—Left: Facial deformity resulting from right mandibular hemisection, together with scarring from former operation. Right: Restoration of facial contour with preformed tantalum implant. Insert: Preformed tantalum implant for facial restoration

The patient had a highly unpleasing facial appearance, resulting from hemisection of the mandible on the right side (Fig. 9, left). The skin of the submandibular area was scarred badly from the symphysis to the angle. This side of the face was depressed, and contracture of the scar had drawn the remaining bone fragments across the midline. The disfiguration had exerted a dominant influence upon the patient's mental attitude and future outlook.

Treatment.—The patient was anesthetized with ethylene gas and ether, and the space originally occupied by the mandible was entered through an incision extending from the symphysis to just below the lobe of the ear. A previously constructed tantalum form (Fig. 9, insert) was attached anteriorly to the unaffected bone with tantalum wires. Posteriorly the rounded head was butted into the scar tissue beneath the glenoid fossa. The wound was tightly closed, using ooo chromic for the muscle and interrupted silk sutures for the skin.

Healing occurred by first intention. There was no discharge from the wound and a minimum of tissue reaction. The sutures in the skin were all removed by the sixth postoperative day, and the patient was discharged on the eighth day after operation (Fig. 9, right). Much more spectacular than the cosmetic and functional results was the improvement in the patient's mental attitude.

CASE 8

A man, aged 27, was admitted to the hospital as an emergency case on November 25, 1944, after he had sustained a gunshot wound of the face while deer hunting.

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Fig. 10.—Gunshot wound of face with considerable loss of mandible and left side of maxilla

Examination.—The 32-caliber bullet struck the under surface of the left side of the mandible and coursed upward at an angle to evolve through the upper left malar region (Fig. 10). The mandible had been destroyed from the angle on the left side to the molar region on the right side. A fragment of bone, containing the lower right bicuspids and cuspid and retaining some periosteal attachment, was replaced and wired to the stump on the right side. This fragment of bone survived so that the extent of complete loss of bone was from the angle on the left side to the cuspid region on the right side.

Treatment.—After healing of the soft tissue was complete, an effort was made to hold the segments of jaw in a nearly normal position by placing wires through the angles of the mandible on each side and anchoring them to one another behind the neck (Fig. 11, left). The contest between bone and muscle pull soon caused the wires to cut through the bone and become detached (Fig. 11, right).

A tantalum splint was fashioned to measurements and attached to either end of the bone segments with tantalum wire (Fig. 12, left).

Course.—The splint has been well tolerated and the bone segments have been held in a position suitable for bone grafting (Fig. 12, right). The facial outline has been well preserved and the jaws have a fair degree of function.

COMMENT

It is not believed nor do we wish to leave the impression that we infer that there is any biologic stimulation of the tissue by tantalum. The acceptance of the metal by the body tissue is a result of its inertness and consequent lack of interference with the tissues in their normal reparative processes. Tantalum possesses no germicidal properties.

According to macroscopic and microscopic evidence there is no foreign body tissue reaction to tantalum implants. On examination, sections of tissues adjacent to the metal are found to be composed of a thin, shiny film of fibrous tissue composed of fibroblasts, beyond which the tissues are without edema or inflammatory change.

Fig. 11.—Left: Silver wires placed through angles of mandible on each side and anchored to one another behind neck. Right: Rarefaction of bone at angle of mandible owing to muscle pull allowing posterior traction on bone segments to be released

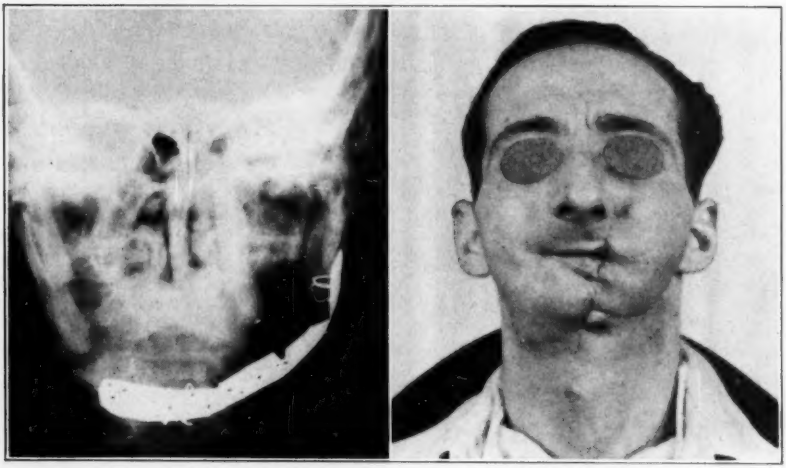

Fig. 12.—Left: Tantalum splint fashioned according to predetermined measurements and attached to bone segments to maintain them in satisfactory position for subsequent bone graft. Right: Facial contour has been fairly well preserved by use of the splint, and the mandible is able to function as a unit. Further facial repair and bone graft remain to be performed

The tissue is not discolored, and the metal shows no evidence of corrosion.

In conclusion, it is requested that this paper be regarded as a preliminary report. The observations are our own, and study of a larger series of cases after a greater lapse of time may result in different conclusions. Judging by our experiences to date, however, it would appear that tantalum will be a valuable adjunct to the field of maxillofacial and oral surgery.—*West Grand and Hamilton Boulevards.*

THE VALUE OF WRITING CASE HISTORIES

Reed O. Dingman, M.D., D.D.S., M.S., and*
James R. Hayward,† D.D.S., M.S., Ann Arbor, Mich.

The diagnosis of pathologic conditions of the oral cavity as well as that of any of the myriad diseases which afflict the human organism should be made upon the basis of subjective and objective findings. An adequate and accurate diagnosis might conceivably be established by consideration of only one or the other type of findings, but both a carefully taken history and a physical examination are necessary preludes to a satisfactory and complete diagnosis.

In oral pathology we frequently attempt to arrive at a solution to a diagnostic problem by objective findings alone, with utter disregard for the history of the patient. This method undoubtedly results in numerous errors, final embarrassment to the diagnostician and dissatisfaction on the part of the patient.

In many cases, a well taken history, properly dated, carefully written and correctly evaluated will establish a tentative diagnosis. Conversely, a history may be valueless and extremely misleading if hurriedly taken and improperly evaluated.

About 150 general systemic diseases have oral manifestations. One is impressed immediately with the importance of the oral surgeon's knowledge of those more common diseases that have obvious oral symptoms. Although it is not within the scope of our specialty to diagnose and treat many of these conditions, we may, by taking an accurate and concise history, arrive at a tentative diagnosis that will enable us to refer the patient to the proper practitioner for treatment.

Taking a medical case history is an art and a science requiring ingenuity, judgment, tact and a breadth of clinical experience extensive enough to enable one to search out and evaluate the important facts concerning a patient. A brief history containing salient facts is obviously more valuable than one written at length, containing an abundance of irrelevant material presented in an incoherent manner.

To the young man in the field this may sound discouraging. However, if he makes a practice of taking histories routinely in a careful, orderly, systematic manner, he soon will discover that it is not as difficult as it appeared on the surface. Not only will carefully taken case histories aid him in diagnosis but they will afford a complete record system. A careful study of such accumulative data will eventually result in the crystallizing of very definite ideas regarding diagnosis and treatment of the various oral pathologic conditions.

A careful and complete case history has two promptly expedient functions: (1) Through the notation and interpretation of signs and symptoms, one is able to evaluate and diagnose the present illness under consideration, and (2) with the sound background of past history, systemic review and family and social history, we may fit the present illness into its proper perspective and at the same time detect associated conditions which alter significantly the prognosis and program of management.

Case histories should be written so that the material can be studied carefully and co-ordinated at the completion of the examination. After some practice in taking

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histories, the examiner may jot down notes as he goes through the routine, and after the examination write the case history in detail, at his leisure. This material might be invaluable later in the event of medical-legal proceedings.

Various printed forms are available that list the main headings and leave space in which the information is to be written. These are not desirable, because in many instances there is insufficient space in which to accommodate the material adequately. These stereotyped forms also contain spaces for information which might be highly irrelevant to the case under consideration. The standard plain white 8½ by 11 inch history sheet is the most practical. This sheet allows for expansion if necessary; it contains no irrelevant material, and it permits ease in handling and filing.

Technics for taking case histories must be sufficiently adaptable to fulfill the needs of the case at hand. For completeness and clarity a main sectional outline is helpful. The information may be recorded briefly in a skeleton of salient facts having both immediate and future value in the management of the case. If one detects a sign or symptom suggestive of abnormality, while covering the various phases of the history, that particular section should be thoroughly investigated for all contributing facts. If the concise, factual information completes the basic outline without suggestion of dysfunction or disease, any detailed expansion is superfluous.

Even those men with wide clinical experience will find that a method of taking outlined routine history is an invaluable aid if the manifest signs and symptoms are indefinite. The following basic history outline is suggested:

1. *Chief Complaint* (C.C.).—This is a statement of what is most noted and complained of by the patient. It should be short and in the patient's own words. For example: tumor of the tongue, swelling of the jaw, sore mouth.

2. *Present Illness* (P.I.).—This should be a report of the chronologic development of events leading to the chief complaint. The patient should develop this in his own words as nearly as possible. Many patients, however, will consume time in endless rambling on irrelevant subjects. In these cases, the facts regarding the present illness must be drawn from the patient by careful questioning. This information should include the exact date of onset; the first symptoms noted (fever, chills, sweats, pain) and the progress of such symptoms from day to day; the date of giving up work and the date when the patient last felt well. Statements should be included regarding such constitutional symptoms as fever, night sweats and changes in weight, strength and color. Information on the present illness should also include the patient's own idea of his illness and his previous examinations, the findings and treatment. As nearly as possible, questions should be limited to one or two words and short, concise answers should be demanded.

When definite symptoms are present they should be carefully elaborated, as variations in the character of the symptoms may prove to be important factors in the differential consideration. For example, a patient complains of pain in the jaw and claps his hand to the side of his face. This gesture means very little, for the hand probably covers sensory areas supplied by the second and third divisions of the fifth cranial nerve. The pain is finally localized in the right cheek, just above the angle of the mouth, within the area supplied by the second division of the fifth cranial nerve. By further questioning, one learns that the pain comes on suddenly without warning; that it is severe, shooting and lancinating in character, and lasts from ten to thirty seconds. Successive attacks occur with greater frequency. A dolorogenic or trigger zone may or may not be located. At this point, the examiner probably has made a tentative diagnosis of tic douloureux. But, on learning further that, between

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the attacks of severe pain, there is a faint, dull, boring, burning pain, associated with a slight area of loss of sensation, the surgeon may make a diagnosis of tumor involving the gasserian ganglion or the second division of the fifth cranial nerve. Malignancy of the maxillary antrum or of the fossa of Rosenmüller is also a common cause of this type of pain.

It is highly important to analyze pain in the oral cavity carefully. As an illustration closely paralleling the previous example, a patient may have intermittent pain of a sharp, lancinating character in the tongue or palate. He has been unable to eat solid foods for some time because eating initiates the pain. By further questioning it may be learned that food in the anterior part of the mouth causes no difficulty, but that the pain is initiated when the patient attempts to swallow. This information leads one to suspect a tic of the ninth cranial nerve rather than the fifth, which affects the anterior part of the tongue or palate. The pain is superficial as contrasted with the deep pain of atypical sphenopalatine neuralgia, which also has an insidious and gradual onset.

When pain is a symptom, one should record: the regions involved; the area and point of maximum intensity; its character (dull, aching, sharp, lancinating or wavelike); how it is induced; how relieved and aggravated; its relation to effort, meals and posture; the time of onset and duration; faintness, giddiness, nausea, vomiting, fever and other associated phenomena; what treatment has been given, and what relief there is from treatment.

If the symptom is headache, one should record: the time of onset; its duration, periodicity and locality (frontal, occipital, lateral, superficial or deep); any change of its locality; its radiation or extension with movement of the head; how the pain is relieved; the effect of stooping, reading, sewing and light; its relation to food, effort, posture, constipation, excitement and menstruation, as well as any family history of headache, allergy or epilepsy.

If cough is present, one should determine if it is dry, moist, hoarse, spasmodic, clanging or brassy; the time of occurrence; its frequency and provoking cause; whether there is a tickling sensation, pain, dyspnea, nausea or vomiting and the appearance and quantity of sputum.

Symptom complexes or patterns of symptoms often are important in the establishment of a diagnosis. Questions properly directed may lead to the development of these complexes or patterns, which will suggest a diagnosis from the history alone. For example, a boy, aged 14, enters the clinic for examination. The chief complaint is swollen jaw. During the taking of the history the patient is drowsy and responds slowly to questioning. His behavior is abnormal and suggests underlying disease. On questioning, it is discovered that three weeks earlier a boil on his buttock was lanced. During the past several months he has had several boils and skin infections and now has an abscessed tooth. "Just one infection after another," his mother volunteers. It is not normal to have so little resistance to infection. Perhaps he has diabetes. Response to further questioning establishes the fact that in spite of a ravenous appetite, the patient has lost weight. He drinks excessive amounts of water, urinates very often and sleeps most of the time. This symptom complex of polyphagia, polydipsia and polyuria, with loss of weight and exhaustion is highly indicative of diabetes mellitus. A urine analysis shows glycosuria at 4 plus and a 4 plus reaction for acetone bodies. This patient is on the verge of diabetic coma, and surgical treatment of the abscess of the mandible without the administration of insulin might cause death.

3. *Past History.*—This section of the outline includes (a) general health prior to the onset of the present illness, (b) diseases of childhood (date, duration, severity and sequelae): measles, mumps, whooping cough, diphtheria, scarlet fever, chickenpox, chorea, acute rheumatic fever or sore throat, and vaccines or serums administered (it is always wise to check the character of the disease in order to confirm the previous diagnosis), (c) other diseases and their outcome: malaria, typhoid fever, pneumonia, pleurisy, rheumatism, poliomyelitis, tuberculosis, gonorrhea, lues (chancre, mucous patches, sore throat, skin eruption, loss of hair or nails and the treatment used), (d) trauma, operations, hospitalization and (e) history of allergy.

4. *Systemic Review* (history of each system).

(a) Head

Eyes: Use of glasses, history of failing vision, pain, double vision, inflammation or ocular pain.

Ears: Loss of hearing, pain, discharge or tinnitus.

Nose: Colds, epistaxis, drainage and olfaction.

Mouth: Usually complete under section on present illness.

(b) Cardiorespiratory system: Cough, expectoration, hemoptysis, night sweats, palpitation, retrosternal or precordial oppression or pain (relation to effort, its radiation), swelling of the ankles, orthopnea and blood pressure.

(c) Gastro-intestinal tract: Appetite, eating habits, bowel habits (number and character of stools, and blood, mucus or parasites visible), nausea, vomiting (descriptive details), jaundice, pain (character and relation to eating), flatulence, hemorrhoids, condition of the tongue and dysphagia.

(d) Genito-urinary tract: Urination, frequency, pain, difficulty in starting stream, blood, pus, number of times during day or night and venereal disease.

(e) Neuromuscular system: Headache, dizziness, insomnia, fainting, nervousness, epilepsy, twitching, spasms, cramps, weakness, paralysis, ataxia, abnormal sensory disturbances, neuralgia, wasting, rigidity, aphonia, aphasia, defects in special senses and organs of special sense and personality changes.

(f) Bones and joints: Fractures, arthritis, deformities, swelling and limitation of motion.

(g) Menstruation: Regularity, character, duration, pain, age of onset, intermenstrual discharge, age at menopause and date of last period.

(h) Marriage: Years of marriage, number and health of children, health of mate, miscarriages (causes if known), number of pregnancies and whether the marriage is happy or unhappy.

(i) Habits: Use of tobacco, alcohol or drugs. Work, and its character and surroundings. Sleep, exercise, recreation; occupational and social adjustment.

5. *Family History.*—This section includes data regarding father, mother, brothers and sisters; whether members of the immediate family are living, and if so, their state of health and age. If members of the immediate family are deceased, the cause and age at death should be noted. Occurrence in the family, including grandparents, aunts, uncles and cousins, of a condition similar to the patient's should be recorded, or that of tuberculosis, malignancy, heart and kidney disease, apoplexy, hypertension, nervous and mental disease, diabetes, death through intestinal disease, syphilis, gout or blood diseases.

Logical deductions from the symptomatology and the clinical course recorded in the preceding data should aid the oral surgeon in forming the basis for a tentative diagnosis before proceeding with the physical examination.

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In addition to providing a background of symptomatology and course, as well as an epitome of the general condition, the facts revealed in taking the history may clinch a diagnosis dramatically. For example, a boy, aged 13, came to the clinic with the chief complaint of swollen gums. He had been seen previously by three different dentists who attempted surgical removal of the hypertrophied tissue which only recurred in greater abundance each time. Questioning revealed a history of "spells" during the past six years and regular consumption of anti-convulsive drugs. The diagnosis of specific Dilantin hypertrophic gingivitis was confirmed by all other findings.

The solution of several refractory diagnostic problems in a case of obscure stomatitis follows a similar pattern. At first the findings in the history of the patient, a woman, aged 52, with a persistent generalized stomatitis, were completely negative. An allergic manifestation was suspected, but the patient denied taking any drugs or medicines and had no other symptoms of sensitization. After being questioned repeatedly, she suddenly remembered that she took a phenolphthalein preparation regularly for chronic constipation. Habitual use had masked the importance and consciousness of the drug consumption. Further findings and course confirmed the diagnosis of a phenolphthalein stomatitis medicamentosa. This case significantly demonstrates that thorough, penetrating questioning is often necessary to expose facts which may be veiled by subjective reactions of indifference and forgetfulness, and blocks caused by association with unpleasantness or embarrassment.

Standard abbreviations are permissible and desirable in taking a case history. They may serve to lessen the time necessary to write a complete history. A condensed form of outline for reference during history taking may be helpful.

1. Chief Complaint
2. Present Illness
   a. Onset
   b. Course
   c. Treatment
   d. Constitutional symptoms
3. Past History
   a. General health
   b. Previous disease, trauma, operations, hospitalization
   c. Allergic history
4. Systemic Review (including marital history and personal habits)
5. Family and Social History

A number of valuable observations may be made during the course of taking and writing a case history. Although such observations actually fall within the province of the physical examination and not within the discussion of history writing, mention at this time is desirable in order to emphasize their pre-eminent importance. In a sense, we are all detectives. We must develop our special senses to the highest degree, especially our sense of observation. Before resorting to palpation, percussion or auscultation, we must give our eyes a chance to observe. Many impressions may best be gained in the short interval during which the history is being taken.

Mental State.—A fair estimate of the patient's mental condition should have been gained by the time the history has been taken. Our diagnosis of psychosis and neurosis must necessarily be made by what the patient says and the manner

in which he says it. Insanity and delusions will be quite obvious; patients with hysteria will show emotional instability, and the neurasthenic will betray himself by his mode of dress, low spirit, symptom complexes and phobias.

Mode of Approach.—The ambulatory patient may show by his energetic gait and erect carriage that his illness is recent and not grave, whereas the slow deliberate gait and bent figure may indicate a serious chronic illness or depressed mental condition. The gait of tabes dorsalis, paralysis agitans and hemiplegia is characteristic.

Facial Expression.—Valuable diagnostic data may be obtained by observation of the play of the patient's facial muscles. The hysterical and neurasthenic facies are unmistakable. The facial expression may convey states of pain, anxiety, uneasiness or care and may be a valuable index to the severity of the patient's condition. Fever may be evidenced by a flushed skin. Adenoid facies, acromegalic facies and absence of the function of facial muscles in Bell's palsy are characteristic.

Position in Bed.—This observation may identify typhoid fever, pneumonia, cardiac disease, meningitis, peritonitis and many other conditions.

State of Nutrition.—Marked loss of weight usually is indicated by wrinkling of the skin and loose fitting clothing, and immediately suggests malignancy, tuberculosis, diabetes or thyroid disease.

Skin and Mucous Membranes.—Color of the skin, gums and lobes of the ears, noted during conversation with the patient, may suggest the anemias. Jaundice, cyanosis and pigmentation may be obvious. Leukoderma colli or other secondary syphilids may be noted.

Hair, Hands and Nails.—The dry coarse hair of myxedema or the blotchy alopecia of syphilis may be noted. Cleanliness or lack of care of the nails may throw some light on the personal habits of the patient. Cyanotic watch glass fingernails and clubbed fingers may indicate congenital heart disease or chronic lung disease.

Lymph Nodes.—Enlargement of the cervical chains makes one consider Hodgkin's disease, tuberculosis or neoplasm, primary or metastatic.

Cough and Expectoration.—These signs may lead one to consider tuberculosis, aneurysm of the aorta, bronchiectasis or pertussis.

The quality of the breathing, character of the voice and speech, appearance of the eyes and the inability to hear are other points that can be observed. Notched incisor teeth, ulcerative gum conditions, missing teeth and advanced pyorrhea may be noted.

Odor of the breath may indicate chronic alcoholism, diabetes, pulmonary gangrene, uremia, carcinoma or other conditions. The body odor may suggest typhoid fever, syphilis or carcinoma.

The hands may reveal congenital heart disease or chronic lung disease, arthritis, gout, acromegalia or myxedema.

Edema of the face and eyelids would lead one to suspect nephritis, and swelling of the ankles might suggest nephritis or a cardiac disease.

Numerous other examples could be cited, but those mentioned are sufficient to show how vast a fund of knowledge can be gained by merely observing the patient during the period in which the history is taken and before the actual examination is begun.

Conclusions.—In order to co-ordinate the data presented by the patient, a brief and efficient technic is imperative. When symptoms are properly grouped for evaluation in a concise case history, they become a foundation upon which one may develop

further diagnostic steps and therapeutic measures. History taking is an art to be mastered through experience, exact knowledge of altered function in disease and a wide appreciation of human reactions. While investigating the symptomatology, the clinician also must utilize his opportunity to make keen observations on those aspects of the case available for inspection. When a history has been carefully taken and completely evaluated, as previously outlined, the examiner should feel that he has developed a substantial foundation upon which to establish a diagnosis.—*University Hospital, University of Michigan.*

Penicillin Therapy and Free Bone Grafts

Eight patients have been studied in which free bone grafts have been implanted successfully in infected defects in bones in conjunction with penicillin treatment. Seven of these patients had infected fractures of large bones of the lower extremity with nonunion, and one had a contaminated defect resulting from an extensive resection of bone following removal of a secondarily infected tuberculous knee joint. The pathogenic bacteria cultured from the wounds of these patients were hemolytic Staphylococcus aureus in 4 cases, beta hemolytic streptococcus and hemolytic Staphylococcus aureus, 2 cases, Escherichia coli and hemolytic Staphylococcus aureus, 1 case, and Streptococcus viridans and hemolytic Staphylococcus albus, 1 case. Systemic penicillin was given intramuscularly at 3 hour intervals before operations in 5 of the cases, and after operations in all of the cases. The dosage varied from 100,000 to 200,000 units per day. Prolonged treatment extending over many weeks was necessary. The total amount of penicillin used in each of these cases varied from 3 to 8 million units.

The free bone grafting operations consisted of insertion of iliac grafts and metal plates, 4 cases; sliding bone graft and metal plates, 1 case; iliac grafts without metal fixation, 2 cases; and sliding bone graft without metal plating, 1 case. The operative wounds were closed completely in 7 cases and in 1 case the wound was closed around a small soft rubber tube through which supplementary treatment with local penicillin was given. The most recent bone grafting operation was done 3 months ago and this wound has not yet been inspected, but there are no signs of infection and the patient has left the hospital with plaster fixation. Immediate primary healing has resulted in 4 cases; however, in 1 of these cases an adjacent sinus tract reopened following the operation and drained temporarily, and another patient returned for treatment of an infection that

developed 6 months after operation. Two wounds developed necrosis and low grade infection resulting from tension at the site of closure, and these have required secondary closure and skin grafting procedures. One wound became infected and required drainage, but the patient was receiving inadequate doses of penicillin at the time.

At present the wounds of 6 of the 7 patients with grafting operations for infected nonunited fractures are healed completely, and 1 (which became infected 6 months after operation) is under treatment. By x-ray examination the bone grafts in all of these cases appear to be viable and in proper position, but 1 graft in a defect of the tibia fractured 4 months after operation and required a supplementary (fibular transplant) procedure. None of the grafts has sequestrated, extruded, or been absorbed. Four patients have firm union of the fracture sites with metal plates still in position, and 2 have firm union without metal plates. One patient has not yet had the original plaster dressing removed, and the remaining patient is the one in which fibular transplant was required because the graft in the tibial defect fractured 4 months after the bone grafting operation.

Even though it has been possible under penicillin therapy to accomplish free bone grafting directly into the infected bone defects successfully in these cases, it is probably more desirable in most instances to attempt to obtain healing preliminary to the grafting procedure by penicillin therapy and, if necessary, operations for removal of sinus tracts, infected granulations, scar, and nonviable bone. The bone grafting may then be accomplished at a later operation in a relatively cleaner field. Adequate dosage with pencillin is a useful adjunct in all such cases in which bone grafting and other operations are done in areas in which there are bone defects infected with penicillin-susceptible organisms.—*Abbott et al., in Surg., Gynec. & Obst. 83:105, July 1946.*

NITROUS OXIDE AND POTENT SYNERGISTS IN ORAL SURGERY

Harry M. Seldin, D.D.S., New York

Historically, the technics for inducing anesthesia which have been developed in dental practice have kept pace with the expansion of simple exodontia into the wide and complete field of general oral surgery. This was a natural consequence of the peculiar necessity of dental surgery to evolve anesthetic methods adapted to its procedures and limitations. The practice of oral surgery is unique insofar as practically all of the operations included in its category are performed in private offices upon ambulatory patients. It is only the rare and exceptional case which requires hospitalization. The majority of the operations require five minutes or less to complete.

Although the hospital anesthetist has at his disposal a large number of anesthetic drugs and, of course, the facilities for their proper application, the dental anesthetist is perforce limited in his selection of anesthetic agents. It is neither feasible nor necessary for a dental patient to undergo a thorough physical examination, such as is imperative before administration of an anesthetic for major surgery in a hospital. Further, the patient in a dental office must recover fully from the anesthetic as quickly as possible after its withdrawal, in order to be able to function normally and to leave the office. For this reason, premedicants and narcotic synergists must be utilized sparingly, and it is obvious, therefore, that the dental anesthetist has a relatively greater problem than has the hospital anesthetist.

However, the problem has, in great measure, been satisfactorily solved through the use of procaine for local anesthesia and nitrous oxide for general anesthesia. Both anesthetics, when properly and skillfully administered according to the scientifically established principles and technics, are ideal for dental operations. For the difficult and complicated cases requiring anesthesia, in which nitrous oxide with oxygen is inadequate, Vinethene, Metopryl and Pentothal Sodium may be used as synergists in conjunction with it, or each may be used individually according to the indications. This group of drugs constitutes a complete and effective arsenal for our unremitting war against operative pain.

With regard to general anesthetics, clinical dental experience has universally selected nitrous oxide as the drug of choice since it conforms more closely to the qualifications for an ideal dental anesthetic than any other. It is noninflammable and nonexplosive and it forms no compounds within the body tissues. When prolonged and severe hypoxia is avoided, it neither interferes with nor alters the body functions. It is nonirritating and pleasant to take and produces an excellent analgesic stage. It is safe in the hands of those trained in its administration and produces a light plane of anesthesia with a minimum of nausea. Recovery is rapid, for the anesthetic is quickly reversible.

It is true that the introduction of any anesthetic drug into the human body disturbs normal function and upsets the physiologic balance and, in excessive dosage or allergic manifestation, often proves toxic. It is equally true, however, that by skillful administration of the drug and by close observation such effects can be minimized and damage to vital function completely avoided. Nitrous oxide should

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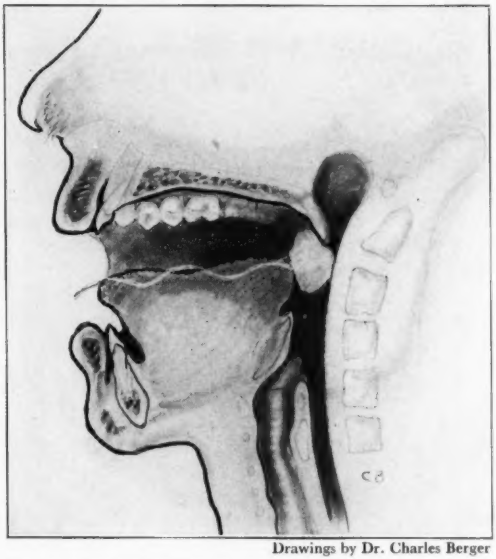

Drawings by Dr. Charles Berger

Fig. 1.—Sagittal section of head illustrating the obstruction of the airway by a mouth pack. The pack is too small and placed too far posteriorly, shutting off the airway at the oropharynx

never be forced beyond the limits of safety based upon our knowledge of its properties and effects. In order to eliminate the danger of secondary saturation, while subduing or leveling the resistant or obstreperous patient, a synergist in the form of a more potent anesthetic should be added. Any of the three in the group previously mentioned—Vinethene, Metopryl or Pentothal Sodium—will, together with nitrous oxide and oxygen, produce smooth anesthesia with a greater margin of safety.

Hypoxia, varying in degree only, occurs with all anesthetic agents in current use, including Pentothal Sodium and those used in spinal anesthesia. This has been proved despite the general impression that only with nitrous oxide does such a condition arise. That anoxia may be brought about by the improper administration of any anesthetic agent is shown by Schreiber,[1] who reported nine cases of severe cerebral damage and death. Nitrous oxide, Avertin and nitrous oxide with ether were responsible for one fatality each; five cases of brain damage followed spinal anesthesia; and one asphyxial episode resulted in irreparable personality change when a tonsillectomy was performed under local anesthesia in which a ½ per cent solution of procaine was employed. We see that Schreiber was "impressed by the number of cases in which cerebral degenerative changes date directly from the administration of spinal anesthesia. The symptoms for which the patient has been operated on may have disappeared and their place been taken by an entirely new set of complaints relating to the brain."

It has been clearly shown by Courville[2] that ether anesthesia can produce cerebral

1. Schreiber, F., Cerebral Anoxia and Anesthesia. *J. Mich. State Med. Soc.* 38:1050 (December) 1939.
2. Courville, D. B., Ether Anesthesia and Cerebral Anoxia: Study of Causative Anesthesia Complications. *Anesthesiology* 2:44 (January) 1941.

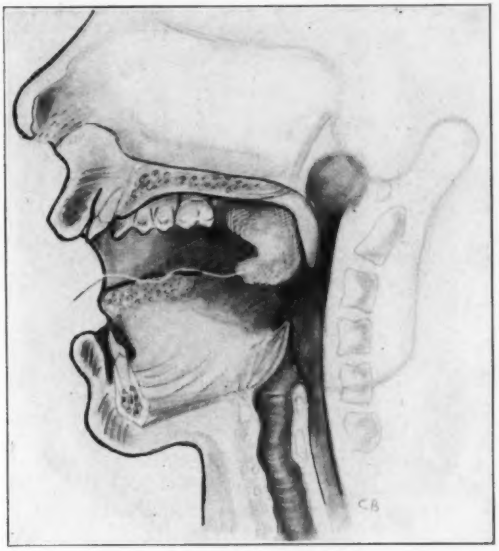

Fig. 2.—The maintenance of an open airway is of paramount importance during anesthesia. Sagittal section of a head illustrating proper position of the mouth pack to exclude air and to maintain an open airway

anoxia. So-called ether convulsions are definitely the clinical result of cerebral hypoxia. Further, Steegmann[3] reports four cases of prolonged anoxia in which brain damage was caused. Nitrous oxide was used in two of these and Avertin and cyclopropane in one each of the others.

After an exhaustive study of the effect of anesthetic drugs upon animals and human beings, McClure, Hartman, Schnedorf and Schilling[4] demonstrated that all anesthetics produce hypoxia, especially the barbiturates, such as Pentothal Sodium. The authors write that " . . . with this study and comparison of the various commonly used narcotics and anesthetics, it becomes apparent that anoxia of some degree and of one or more types usually occurs as a result of their administration. Ordinarily this anoxia is not of sufficient degree to endanger the patient's life or tissues . . . barbiturates in therapeutic doses produce relatively severe anoxia by respiratory depression (anoxic type), circulatory depression (stagnant type) and reduction of cellular respiration, especially the brain (histotoxic type). Only the elimination of the barbiturates in large preoperative doses and as anesthetics will prevent anoxia."

This does not imply that ether, Pentothal Sodium or nitrous oxide should be eliminated as anesthetics or that spinal anesthesia should be discontinued. On the contrary, each has its place in pain alleviation. Art in anesthesia is the selection

3. Steegmann, A. T., Encephalopathy Following Anesthesia; Histologic Study of Four Cases. *Arch. Neurol. & Psychiat.* 41:955 (May) 1939.

4. McClure, R. D.; Hartman, F. W.; Schnedorf, J. S., and Schilling, N., Anoxia. *Ann. Surg.* 110:835, No. 5 (November) 1939.

Table 1.—Percentages of oxygen at which cases were leveled off

Cases leveled off	Oxygen
56	5 per cent
940	10 "
1219	15 "
1774	20 "
1857	25 "
1684	30 "
894	35 "
1621	40 "
679	45 "
941	50 "
497	55 "
914	60 "
276	65 "
575	70 "
494	75 "
271	80 "
61	85 "
36	90 "
1	95 "

and employment of these drugs intelligently, so that the patient is anesthetized without injury to the vital organs of the body.

Some degree of anoxemia is present after the administration of practically all anesthetics, according to the analytic study of all available reports. Fortunately, however, the body is tolerant of mild degrees of hypoxia, a fact that is apparent in cases of congenital cardiac disease and blood dyscrasias. Patients affected with decompensated hearts develop a chronic stagnant hypoxia owing to inefficient circulation. In leukemia and severe anemias, the oxygen-carrying capacity of the blood is definitely reduced, resulting in anemic hypoxia. Hypoxia becomes dangerous only when it is prolonged or severe.

Mild hypoxia is certainly less dangerous after nitrous oxide administration than after the use of any other anesthetic because nitrous oxide does not depress the protective mechanism of the body. It is rapidly eliminated from the system and is, therefore, readily reversible. There is no necessity for severe or prolonged anoxia to occur when nitrous oxide is correctly administered.

A record of the oxygen percentage employed in each administration of anesthetic is kept in our office. Rapid induction is used in the majority of cases. The patient is first given pure nitrous oxide, and 10 per cent or more of oxygen is added at the first sign of the surgical plane (change in breathing rate, loss of lid or lash reflex or eccentric fixation of the eyeball). The percentage of oxygen in the mixture is rapidly increased until the maximum toleration point of the patient is reached. This of course varies with the individual patient. When the patient appears too lightly anesthetized, the oxygen percentage is reduced gradually until the proper level is attained. Tables 1 and 2 list the oxygen requirement in 14,790 administrations of anesthetic.

These records reveal that most patients will accept a surprisingly high percentage of oxygen with nitrous oxide, without its interfering with maintenance in the third stage of anesthesia. In fact, 20 per cent oxygen in the anesthetic mixture for 85 per cent of the patients proved to be a bare minimum. These patients were being given, with the nitrous oxide, at least as much and usually much more oxygen than is found in atmospheric air. Those few patients (15 per cent) who demanded low oxygen percentages seemed to tolerate the oxygen deficiency quite well. As

Table 2.—Percentages of patients and proportions of oxygen and nitrous oxide required for maintenance of anesthesia

Patients	Oxygen	Nitrous oxide
.38 per cent	5 per cent	95 per cent
6.37 "	10 "	90 "
8.25 "	15 "	85 "
12.00 "	20 "	80 "
12.56 "	25 "	75 "
11.39 "	30 "	70 "
6.05 "	35 "	65 "
10.97 "	40 "	60 "
4.61 "	45 "	55 "
6.37 "	50 "	50 "
3.37 "	55 "	45 "
6.19 "	60 "	40 "
1.87 "	65 "	35 "
3.89 "	70 "	30 "
3.35 "	75 "	25 "
1.85 "	80 "	20 "
.42 "	85 "	15 "
.11 "	90 "	10 "
.01 "	95 "	5 "

a general rule, aged, anemic and debilitated patients require very high oxygen percentages, whereas the overstimulated types seem to do well on low oxygen percentages in anesthesias of short duration. The old formula of 7 per cent oxygen and 93 per cent nitrous oxide as the average required balance thus has been shown to be definitely wrong in the vast majority of cases. According to computation based upon the foregoing tables, the average mixture would be 36.62 per cent oxygen and 63.38 per cent nitrous oxide. In this series of cases, the length of the periods of anesthesia varied from two to thirty-six minutes. In 72 per cent of the cases, periods of anesthesia were three minutes or less in length, and 88 per cent were five minutes or less.

Anesthetic Accidents.—The possibilities of cerebral damage or death become immediate when any anesthetic is improperly administered or when the patient, because of some organic or metabolic derangement, becomes a poor risk for anesthesia. Such a patient usually may be placed in either of two categories: (1) the debilitated type or (2) the overstimulated type.

The debilitated type, of which the anemic patient is probably the most frequent example, will not exhibit any of the classical symptoms of oxygen want during anesthesia, and, when deprived of the required percentage of oxygen, will become dangerously anoxemic, gradually and without visible warning. The breathing will become progressively slower and shallower until it finally ceases, yet the skin color may remain comparatively good. Constant alertness and close observation of all symptoms, as well as the maintenance of high oxygen percentage in the anesthetic mixture, is vital in such cases. It is important to note that in the anemic patient there may be tissue hypoxia without hypoxemia and cyanosis, because there may be enough oxygen present to saturate the reduced hemoglobin but not enough to support vital main function.

Patients with cardiac disease make up another group of the debilitated type. Those afflicted with severe or even moderate cardiac disease should be considered poor risks for anesthesia and surgery. The anesthetic selected should not place any undue strain upon the heart. In oral surgery, field block or infiltration with procaine is chosen when possible, because procaine causes the least aggravation in cardiac

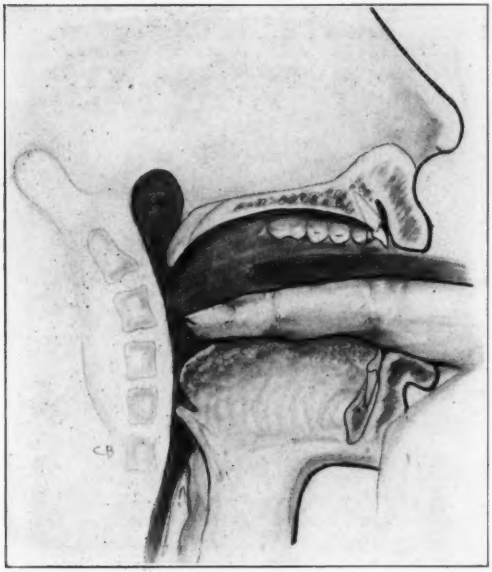

Fig. 3.—Sagittal section of head illustrating the obstruction of the airway by pressure of the finger on the tongue. During extraction, the pressure of the fingers on the tongue may push it back against the epiglottis, forcing it against the posterior pharyngeal wall. Mechanical asphyxia is thus produced

deficiency. The psychologic approach that allays fear is very important to all cardiac patients, and their proper sedation is important.

The cardiac diseases of importance, in relation to general anesthesia, and those most commonly met are: (1) cardiac decompensation; (2) coronary disease, and (3) hypertension.

Cardiac Decompensation.—Valvular lesions are usually caused by rheumatic fever or syphilis. Decompensation may be caused by disease of the coronary artery, aortic stenosis, aortic insufficiency, mitral stenosis or the failure of the left ventricle to empty itself with each contraction. A patient giving a history of edema or one showing symptoms of edema of the ankle with pitting upon pressure, dyspnea on exertion and orthopnea should be included in this group.

Local anesthesia or, in short operations, nitrous oxide with high oxygen percentages is best chosen in such cases. In prolonged surgical procedures, Pentothal Sodium, 1 to 2 per cent, with 50 per cent each of nitrous oxide and oxygen is indicated.

Coronary Disease.—These patients usually give a history of substernal or anginal pain. They cannot tolerate hypoxia, especially of the cardiac muscle. High oxygen concentration in the anesthetic, therefore, is imperative. The stage of excitement must be avoided, as the extra strain upon the heart caused by the strenuous exertion may bring on a coronary spasm or myocardiac infarction. Local anesthetics should be employed whenever possible. If local anesthesia is contraindicated, nitrous oxide with high oxygen percentages and the avoidance of the stage of excitement by ade-

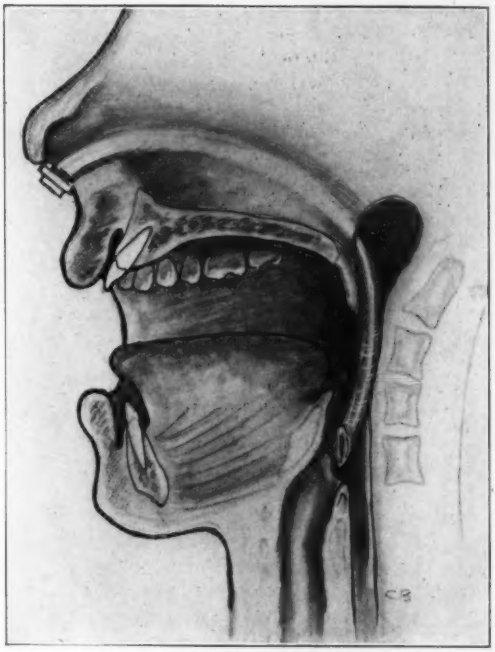

Fig. 4.—Sagittal section of the head illustrating proper position of nasopharyngeal tube

quate premedication or 1 to 2 per cent Pentothal Sodium with nitrous oxide and a minimum of 50 per cent oxygen are the anesthetics of choice.

Hypertension.—Elevation of the blood pressure may be systolic alone or both systolic and diastolic. The coronary arteries depend for their blood supply upon the diastolic pressure. A sudden fall in diastolic pressure, therefore, may produce severe hypoxia of the cardiac muscle, resulting in heart failure. Nitrous oxide with high oxygen percentages will not cause a drop in diastolic blood pressure and is indicated for anesthesia of short duration.

Patients afflicted with severe heart ailments should be properly digitalized by their cardiologist whose consent should be obtained before a general anesthetic is administered.

The alcoholic addict, on the other hand, the most common of the overstimulated types, invariably will resist anesthetization, and to force the nitrous oxide and oxygen during the struggle which usually ensues is extremely hazardous, since the patient may suddenly pass from the stage of excitement to the dangerous or fourth stage. Resuscitation then becomes difficult and, when complicated by cardiac ailments, may prove impossible. Patients in the overstimulated groups can be anesthetized with comparative ease and safety by the addition of a heavier anesthetic drug such as Pentothal Sodium, Vinethene, or Metopryl to the nitrous oxide and oxygen combination. Each of these drugs is a valuable adjunct in dental anesthesia and it is well to be fully conversant with their effects and technics of administration.

Pentothal Sodium.—This drug does not lend itself to unrestricted use as a principal anesthetic in prolonged oral surgery in the office because it is potentially dangerous if infections of the floor of the mouth or cellulitis of the neck are present. Infection and inflammation in the region of the carotid bodies interfere with the protective respiratory reflexes arising in that region, and since Pentothal Sodium has a depressing effect upon the respiratory centers, as dosages and concentrations are increased, complications of a severe nature might develop.

As a synergist, however, in operations free of involvement in the danger regions and in those of moderate duration, Pentothal Sodium is most satisfactory. It is, of course, administered by intravenous injection. The median basilic vein in the antecubital fossa or a dorsal metacarpal vein on the dorsum of the hand is selected. The smaller veins are straighter and venipuncture is consequently easier, as the needle can be readily inserted for ½ inch or more. A 1¼ inch 23 gage needle is used, and a 1 inch Penrose drain or a ⅜ inch soft rubber tubing is used as a constricting band above the point of insertion.

The site of puncture is sterilized and the skin over the vein held taut. The syringe is held horizontal to the vein, bevel up for the larger veins and down for the smaller veins. The needle is passed into the lumen for about ½ inch and a small quantity of blood is aspirated to ensure that the needle is in the vein. Upon the appearance of blood, the tourniquet is released and the needle is slightly withdrawn so as not to block the lumen completely. For our purposes, deep anesthesia is not only unnecessary but should be avoided, for the patient should be held in as light a stage of anesthesia as is consistent with satisfactory relaxation. The average dose is 5 to 10 cc. of a 2½ per cent solution of Pentothal Sodium. As soon as the patient shows signs of light narcosis, a 50 per cent nitrous oxide and 50 per cent oxygen mixture is added for maintenance, and the depth of anesthesia is controlled from that point by varying the oxygen percentage. A light, smooth and safe anesthesia is thus provided in the resistant types. Respiration must be carefully checked at all times and respiratory embarrassment avoided. Resuscitative measures with oxygen under pressure must be instituted when any breathing irregularity occurs.

The administration of 100 per cent oxygen for about sixty seconds will help awaken the patient and hasten the elimination of the anesthetic. Recovery from Pentothal Sodium is slower than from nitrous oxide, and the patient should remain under constant observation until recovery is obviously complete. He should not be permitted to leave the office, however, unless accompanied by a responsible person.

A study of the effect of Pentothal Sodium on gases in the arterial blood was made by Barton, Wicks and Livingstone.[5] They have found that, although the blood oxygen value does not fall under light surgical anesthesia, it does fall when patients are deeply anesthetized.

The addition of pure oxygen or 50 per cent nitrous oxide and oxygen produces a definite increase in the oxygen values of arterial blood. The oxygen and carbon dioxide values resulting from equal parts of nitrous oxide and oxygen were almost identical to those seen if 100 per cent oxygen was used. These authors have also shown that when 50 per cent each of nitrous oxide and oxygen is employed with the Pentothal Sodium, only about ¼ as much Pentothal Sodium was required to maintain the same plane of anesthesia as when Pentothal Sodium was administered alone or with 100 per cent oxygen. They state, "The value of the simultaneous administration of 50-50 nitrous oxide-oxygen with Pentothal as

5. Barton, S. D.; Wicks, W. R., and Livingstone, H. M., The Effect of Pentothal Alone and in Combination with Oxygen or Nitrous Oxide-Oxygen on Arterial Blood Gases. *Anesthesiology* 7:505 (September) 1946.

opposed to giving 100 per cent oxygen and Pentothal is apparent, however, when one considers the fact that blood oxygen and carbon dioxide are equally satisfactory in each instance, while the total amount of Pentothal required is only about ¼ as much. This is important since Pentothal has a cumulative and not always desirable or predictable effect when more than 1 or 1.5 gm. is administered."

Nitrous Oxide-Oxygen-Vinethene.—Another means of avoiding forced administration of nitrous oxide is provided through the use of divinyl ether or Vinethene as a synergist. The Vinethene, in liquid form, is placed in an ether bottle and a mixture of 80 per cent nitrous oxide and 20 per cent oxygen is passed through the bottle. The concentration of the Vinethene is controlled by openings numbering 1 to 7, the No. 2 opening usually dispensing the optimum quantity for induction of the average resistant patient. When the desired plane of anesthesia is attained, the percentage of oxygen is increased in order to maintain as light a degree of anesthesia as is consistent with operative procedures. At this point, the Vinethene can be entirely discontinued. in most cases, and the nitrous oxide and oxygen mixture continued alone.

Nitrous Oxide-Metopryl-Oxygen.—A comparatively recent addition to the list of anesthetic drugs, suitable for use with nitrous oxide and oxygen for the overstimulated patient, is known as Metopryl (n—propylmethyl ether). It is one of the more potent drugs and is valuable as a preventive of hypoxemia. It produces better relaxation than ether does and causes less nausea and vomiting. It does not damage the liver cells, as is the case with Vinethene, and is rapidly eliminated. Another disadvantage encountered with Vinethene, but not with Metopryl, is the possibility of postanesthetic headache and even convulsions. Since Metopryl has an unpleasantly pungent and irritating odor, it is best added only after complete induction with nitrous oxide and oxygen, or sooner, should the patient's behavior warrant it. It is placed in an ether bottle and administered in the same way as is Vinethene, beginning with an 80 per cent nitrous oxide and 20 per cent oxygen mixture which is passed over the Metopryl, increasing the oxygen as symptoms indicate. The anesthesia may be completed with nitrous oxide and oxygen alone after the patient is satisfactorily situated.

Comparative Safety of Anesthesia in the Dental Office and in the Hospital.—The sensationalism and unfavorable publicity which attend the rare case of death during anesthesia in the dental office require an occasional review of data pertinent to this subject in order that loose talk and irresponsible opinion may be confounded by facts and statistics. Official records of mortality during anesthesia in offices and hospitals afford irrefutable proof that, comparatively speaking, anesthesia in the dental office is by far the safer of the two. For example, Waters,[6] in a survey of 50,000 administrations of anesthesia at Wisconsin General Hospital, reported one death per 1,000 cases; and Gillespie found approximately the same rate in 250,000 cases. Mousel, Stubbs and Kreiselman[7] report 47 deaths during anesthesia, in about two years in the Washington area, a ratio of 1 death in 300 cases to 1 death in 8,000 cases.

I submitted a questionnaire[8] to each member of the American Society of Oral Surgeons in order to compile accurate data concerning the specific anesthetic drugs used in members' offices and the incidence of fatality and personality damage resulting

6. Waters, R. M., and Gillespie, N. A., Deaths in the Operating Room. *Anesthesiology* 5:113 (March) 1944.
7. Mousel, H.; Stubbs, D., and Kreiselman, J., Anesthetic Complications and Their Management. *Anesthesiology* 7:69 (January) 1946.
8. Seldin, H. M., *Practical Anesthesia for Dental and Oral Surgery.* Philadelphia: Lea & Febiger, 1947.

from their use. These responses were received from 207 oral surgeons representing every section of the United States:

One hundred ninety-six use general anesthesia in their offices; 11 use local anesthesia only, in their offices, reserving general anesthesia for work done in the hospital; 191 use nitrous oxide; 37 use Pentothal Sodium, either alone or with nitrous oxide; 14 use ether as well as nitrous oxide; 2 use ethylene; 2 use cyclopropane; 40 use Vinethene as a synergist, with nitrous oxide when indicated; 12 use ethyl chloride as well as nitrous oxide, and 1 uses chloroform.

These 207 oral surgeons administered anesthetics approximately 2,429,148 times during the past five years. Fifteen deaths were reported in this series. Nine deaths occurred with nitrous oxide for the following reasons: Two were patients with cardiac disease; 3 died of unknown causes; 1 patient with hypertension died eleven days later; 1 jumped out of a window during induction; 1 died of necrosis of the cord at neck level; 1 patient suffered with status lymphaticus and sarcoma; 4 patients with cardiac disease died during Pentothal Sodium anesthesia; 1 death occurred with Novocaine and Pontocaine, and 1 death occurred under ethylene. The cause was unknown and there was no autopsy. Seven personality changes were reported: reversible in 6 cases and nonreversible in 1.

One oral surgeon reported about 100 cases of slow recovery lasting from thirty minutes to two hours in a total of 30,000 administrations of nitrous oxide and oxygen. Secondary saturation is used by this anesthetist, however, and this probably accounts for the delayed recuperations.

This survey, which is based upon 2,429,148 administrations of anesthetic in routine oral surgery in the office during the past five years, reveals but fifteen fatalities or one per 161,943 cases, in contrast to one fatality in every 1,000 cases, according to Waters and Gillespie, during administration of anesthetics in hospitals. This is a remarkable record of safety for the dental anesthetists as well as for nitrous oxide, which was the anesthetic used in the great majority of cases recorded. However, it should be stated that the anesthetic and surgical risks encountered in the hospitals are invariably more serious and much more prolonged than those seen for oral surgery in the office.

It is of interest that 191 of the 207 oral surgeons designate nitrous oxide with oxygen as the anesthetic of choice, and the preferred synergists as Pentothal Sodium and Vinethene. Only two men in the entire group employ ethylene and one of them reports a fatality with that drug.

There seems little doubt that nitrous oxide with oxygen still remains the best and most popular anesthetic for dental surgery in the office, and that its selection is based upon the knowledge and experience that it provides the safest and most practical anesthetic yet discovered for our purposes.—*57 West Fifty-Seventh Street.*

FEAR, PAIN AND ANESTHESIA

Phillip E. Williams, D.D.S., M.S.D., Dallas, Texas

Fear is a natural human quality. Courage is the overcoming of fear, not its absence. Refusal to acknowledge fear merely emphasizes its presence. Fear is constantly with us, unnoticed and unobserved. Without fear, human beings could not exist, for it keeps us from doing things that would destroy us.

It is only when the danger is new or the situation unfamiliar or immediately threatening that we are conscious of fear. It may be aroused and exaggerated also by unpleasant past medical experiences or by the words of others who have submitted to operations similar to the type about to be performed on the person concerned. Stories of great suffering endured by previous generations have undoubtedly entered into the picture.

A desire for information about a question of medical history led me, not long ago, to consult some of the first numbers of The Lancet, published in London in the third decade of the nineteenth century. I found myself translated to a different world: one where operations were performed without anesthetics and without antiseptics; where any mistake in diagnosis or any clumsiness in operation was published to the accompaniment of every insult and derision which malice could suggest, and where entrance to the medical profession was through apprenticeship. It was a world where venesection was performed on everybody for everything and nursing was done by women of the charwoman class. The study of anatomy depended upon the activities of the resurrectionists, and cholera, typhus and hydrophobia were ever present realities. Phrenology was taken seriously and there still lingered a belief in the possibility of living human beings undergoing spontaneous combustion.

What interested me most were the reports of the operations. It is difficult to believe or imagine at the present time, when even the most trivial operation is performed under some kind of anesthetic, how our great-grandfathers could have been induced to submit to such tortures. Our respect for their courage reaches its highest point when we read that some formidable operation was performed at "the earnest solicitation of the patient." It must be remembered that, before the days of anesthesia, a surgeon was a man to be pointed out in the streets with the same kind of shuddering interest that now would be directed toward the public hangman.

Only occasionally is any reference made to the way in which pain was borne, and then only when it was borne well. One may take it for granted that, as a rule, an operation was performed to the accompaniment of the most heart-rending screams. The following description is taken from Marfie's Romance of Medicine.

> Great drops of perspiration, started by excess of agony, bestrew the patient's forehead; sharp screams burst from him in peal after peal; all his struggles to free himself and escape the horrid tortures are valueless, for he is in the powerful hands as inexorable as death. At the first crisp cut of the scalpel agonizing screams burst from him, and with convulsive struggles he endeavors to leap from the table. But the force is nigh. Strong men throw themselves upon him, and pinion his limbs. Shrieks upon shrieks make their horrible way into the stillness of the room. At length it is finished, and prostrated with pain, weak from his exertions, and bruised by the

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violence used, he is borne from the amphitheater to his bed in the wards to recover from the shock by slow degrees.

A letter is still in existence which was written to Sir James Simpson by a member of the medical profession who had undergone amputation of the leg before the days of anesthetics. In it the writer says:

> Several years ago I was required to prepare on very short warning for the loss of a limb by amputation. A painful disease, which for a time had seemed likely to yield to the remedies employed, suddenly became greatly aggravated, and I was informed by two surgeons of the highest skill, who were consulted on my case, that I must choose between death and the sacrifice of a limb, and that my choice must be promptly made, for my strength was fast sinking under pain, sleeplessness and exhaustion.
>
> I at once agreed to submit to the operation which proved to be more tedious than some which involve much greater mutilation. It necessitated cruel cutting through inflamed and morbidly sensitive parts, and could not be dispatched by a few swift strokes of the knife. I do not suppose it was more painful than the majority of severe surgical operations are, but I am not, I believe, mistaken in thinking that it was not less painful, and that is all I wish to contend for.
>
> Further, during the operation, in spite of the pain it occasioned, my senses were preternaturally acute, as I have been told they generally are in patients in such circumstances. I watched all that the surgeons did with a fascinated intensity. I still recall with unwelcome vividness the spreading out of the instruments, the twisting of the tourniquet, the first incision, the fingering of the sawed bone, the sponge pressed on the flap, the tying of the blood vessels, the stitching of the skin, and the bloody dismembered limb lying on the floor. These are not pleasant remembrances.

Before the days of anesthetics, a patient preparing for an operation was like a condemned criminal preparing for execution. He counted the days and hours to the appointed time. He listened for the surgeon's arrival and watched the production of the dreaded instruments. He surrendered his liberty and, revolting at the necessity, submitted to be held or bound and helplessly gave himself up to the knife. The excitement, disquiet and exhaustion thus occasioned could not but aggravate greatly the evil effects of the operation, which fell upon a physical frame predisposed to magnify, not to repel, its severity.

Such reports as these account for some of the fear and nervousness associated with surgical procedures that have developed through the generations.

Emotionalism inculcated in early childhood may remain for the duration of one's existence. A child's personality, like putty, is plastic and easily malleable. Yet it quickly becomes set and hardened, retaining all the impressions made on it during its plastic phase, exhibiting many reaction patterns in adult life which are the expression of the formative ruts. Thus, the child may grow up with a tendency toward fearfulness, self sympathy or overcompensation, attitudes which will manifest themselves in all spheres. Formation of the earliest memories of most patients begins after the age of four, five or six years and, as a consequence, it is difficult to learn from the patient just what role was played by various experiences.

The oral surgeon, by his sympathetic manner, care, patience and understanding, offers the patient something to rely on. Certain problems and situations lose their frightening aspect because his manner in dealing with them is sure and definite.

Persons who are afflicted with great nervousness, anxiety and even terror should be helped in every manner possible. They deserve kind, sympathetic and gentle treatment. For the surgeon to resort to harshness and force is an admission of defeat,

although the natural inclination is to tell the patient to behave himself or leave the office.

There is no such thing as a simple extraction, at least in the patient's estimation. In many instances, what the oral surgeon considers an elementary type of extraction has been the source of great worry, suffering, loss of sleep and extreme anxiety to the patient. More gross pathologic conditions have developed and more simple conditions have been permitted to become complex and grave through fear, and therefore neglect, than through improper diagnosis or poor treatment.

The office staff may be an invaluable asset in the proper handling of the nervous patient. A cheerful and sympathetic nurse or secretary, who first meets the patient, may be able to calm and reassure him before he meets the surgeon.

In a hospital, the effect of suggestion from the nursing force is extremely great. Nurses who are machine-like, irritable, impatient and demanding may be efficient in giving the exact dose of sedative medicine prescribed but may, at the same time, so disturb the patient by insistence and abruptness of manner that they nullify the benefit from the medication.

A kind, sympathetic nurse who is patient and pleasant is far more calming than any form of medication. Fears rarely are dispelled by drugs, but courage can be instilled by an understanding nurse.

Psychoneurotic symptoms are not imagined. The pain which psychoneurotic patients experience is as real to them and as difficult to bear as organic pain, and has the added factors of fear and anxiety which make it still worse.

There are many variations in the pain thresholds of different persons, ranging from the absolute threshold on up the scale. The absolute threshold is defined as the lowest possible limit of perceptibility of any sensation. Many persons are wont to translate the slightest sensation into a feeling of great pain. Others who have a higher threshold do not seem to express any reaction to sensations such as are produced by the insertion of hypodermic needles and grinding of teeth.

It is interesting to note that many members of the medical, dental and nursing professions possess an absolute pain threshold. When it becomes necessary for them to submit to operations of any sort, they usually subdue their apprehension for the pending ordeal by the self administration of sedatives. They hope that the person rendering the professional services will supplement their premedication, so that their anxiety will be suppressed and they will be oblivious to pain.

One of the best ways by which a dentist may develop a real, practical philosophy concerning dental operations, such as extractions, is by having one performed on himself. This experience will give him a perspective that is most wholesome and cannot be acquired in any other manner. He will see that many little things which he regarded as inconsequential now assume tremendous proportions. So many things that were thought to be trivial now are understood to be the source of great discomfort, if not frank pain.

The eye is the index to the soul. Emotions such as fear, pain, anger and envy readily are seen therein. It is well to observe the eye of the patient during the administration of a local anesthetic or while operating. Frequently the patient's reactions may be seen to be psychic rather than physical. This, of course, calls for the application of good psychology rather than more medication.

Too much cannot be said about pre-anesthetic medication. Any drug which will produce sufficient hypnosis to spare the patient the dread of an operation, without endangering his welfare or creating difficulties in local or general anesthesia, must be

welcomed as a desirable adjunct to pre-anesthetic medication. A patient's reaction to anesthesia and surgical intervention is the total of all stimuli that reach the brain. Dental and oral surgeons are apt to minimize the effect of the emotional and psychic phenomena of a patient about to undergo an operation.

That which is a commonplace experience to anesthetists, dentists, surgeons and hospital attendants is an adventure of terrifying and surprising magnitude to a great many patients. If the patient is hospitalized, the preparation for the operation, the preliminary hypodermic injections, the change of body apparel, the trip on a stretcher to the operating room, the handling of instruments, the surgeon's scrubbing-up, and finally, the presence of the mask over the face, which gives the patient the sensation of suffocating, all produce a corresponding reaction, in many cases out of all proportion to the surgical trauma inflicted in the operating room.

Belief that the patient's respect for the surgeon's professional ability, educational background, general appearance and bedside manner is enough to relieve him of the emotion of fear and anxiety is sheer self delusion. Employment of those medical agents that relieve and quiet the patient's natural defensive mechanism is certainly to be encouraged. Just the administration of a small dose of one of the barbiturate preparations will transform the patient from one filled with dread and terror to one who is calm and unafraid.

No attempt is made to discuss general anesthesia in this paper. Certainly it is the answer to the proper handling of the nervous, high-strung patient who desires to be oblivious to any operative procedure. In many offices general anesthesia has practically displaced and precluded the administration of any other type of anesthesia. No doubt this preference will continue, and through the years the margin of safety will be increased until general anesthesia will be as safe as the administration of any local anesthetic.

During operative procedures performed under local anesthesia, when the patient gives evidence of pain, although the usual signs of anesthesia are present, it is well to believe him. Perhaps anesthesia is not complete. Administration of just a few drops of anesthetic solution at the proper site may make the difference between a painful experience and one that is not too unpleasant.

So many times, when conduction anesthesia of the inferior alveolar nerve is effected, the patient may experience numbness of the lip but operative measures prove to be painful. The statements and action of the patient should not be discounted. Perhaps the cervicofacial branch of the facial nerve may be anesthetized, causing a slight drooping of the lower lip and a tingling sensation. This has been produced by injecting the solution too far laterally and posteriorly into the parotid gland and involving the facial nerve.

When a patient alleges that he is sensitive to a local anesthetic agent, it is well to rely on his statement. In the majority of cases, previous reactions may have been psychic, or perhaps the reaction may have been caused by the epinephrine content of the solution. However, a few persons are highly sensitive to procaine and are thrown into shock by its administration. When this occurs, the patient's behavior is most alarming to the dentist.

It is easy to establish definitely a patient's true sensitivity to procaine by employing an intradermal test. This test consists in making three intradermal wheals on a suitable cutaneous surface, using a control wheal of physiologic solution of sodium chloride. Adjacent to the control wheal, an intradermal wheal is made with a 1 per cent solution of procaine hydrochloride, and closely adjacent to it a third intradermal

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injection is made with a vasoconstrictor, such as epinephrine or Cobefrin. After five minutes the intradermal wheals are examined. If there is any redness about the wheal produced by procaine hydrochloride, one is justified in assuming that the patient is probably sensitive to the agent. The intradermal wheal made with the vasoconstrictor naturally will be blanched for some time. If the patient reacts unfavorably to the vasoconstrictor, the objective signs of tremor, pallor and nervousness will be detected easily, and the patient will complain of such subjective sensations as faintness, palpitation and dyspnea.

Too much stress cannot be placed on the importance of slow injection of local anesthetic solutions. Injecting slowly will certainly obviate many of the untoward reactions that sometimes occur. It has been shown experimentally that 40 mg. of procaine per kilogram of body weight, rapidly injected intravenously, will kill a cat, but that 400 mg. of procaine per kilogram of body weight, injected slowly, may have no harmful effect. An injection given slowly requires two or three minutes to complete, whereas a rapid injection can be given in fifteen or twenty seconds.

Healthy persons usually will tolerate 175 to 225 cc. of a 0.5 per cent solution of procaine hydrochloride, 100 to 125 cc. of a 1 per cent solution or 25 to 50 cc. of a 2 per cent solution of this drug.[1] It is readily seen that, with the small amount that is usually employed, there is a tremendous margin of safety. These injections were given either subcutaneously or intramuscularly.

Toxic reaction to local anesthetics is characterized by a drop in blood pressure, pallor, sweating, weak pulse and occasionally by nausea and vomiting. It may be of two types: (a) circulatory and (b) neurologic, which is characterized by talkativeness, excitation and convulsions.

Circulatory reactions to local anesthetics should be treated by administration of oxygen and certain analeptic agents such as ephedrine or epinephrine. In neurologic reactions, oxygen should be administered by intermittent inflation if necessary, and a soluble barbiturate, such as sodium Amytal or Pentothal Sodium, should be administered intravenously until the reaction is controlled.

Members of no other profession, trade or craft should adhere so closely to the golden rule as should the members of the medical and dental professions. To do unto others as we would have them do unto us should be the measuring stick of everyone engaged therein. To fail to do this would be unbecoming to any practitioner of the healing arts.

The real test comes when the doctor sees his patient at some time subsequent to the operative efforts. If he has done his best, and has employed all the skill within his power, together with care, patience and consideration, he will be glad to meet his patient again. If he has been careless or negligent and has rendered inferior services, of course he will be ashamed to see his patient.

The more that is seen of life and death and of pain and suffering the more clearly it is realized that in the real world outside the walls of medical and dental schools and teaching hospitals there is never a disease to be managed or an injury to be dealt with. There is just a sick child, woman or man to be helped to recover. In short, the real business of medicine and dentistry is not science. It is, in the case of each sufferer, a personal relationship, suffused with sincerity and knowledge by the doctor and trust and dependence by the patient.—*1318 Medical Arts Building.*

1. Subcommittee on Anesthesia, National Research Council, *Fundamentals of Anesthesia.* Chicago: American Medical Association, 1942, p. 87.

DOUBLE LIP

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Double lip is a term used to designate a deformity of the upper or lower lip. It consists of an accessory fold of redundant tissue in the mucosal portion of the lip just inside the vermilion border of the mucous membrane. This accessory fold of tissue gives the appearance of two vermilion margins to the lip (Fig. 1). Double lip occurs in men and women with about equal frequency and generally is noticed on the upper lip. This condition of the lower lip, however, may be seen occasionally (Fig. 2). The deformity is accentuated, especially in the upper lip, when the lip is drawn tightly across the teeth as in the act of smiling. The rolling out of this tissue as the lip tissue is tightened apparently is caused by the normal tension of the mucous membrane at its junction with the vermilion border reacting on this mass of redundant mucous membrane and underlying glandular structures.

The excess fold of lip structure is composed of mucous membrane and immediately underlying submucosal tissues. These latter tissues, composing the major portion of the mass, are made up of loose areolar tissue and a great number of mucous glands. Some authors have stated that the deformity probably is caused by an anomaly of the orbicularis oris muscle. We do not believe that this is true, as in all of our patients the deformity has been made up of an excess of mucous membrane and glandular tissues with no involvement of the muscles or deeper structures of the lip. Moreover, the deformity was not evident when the orbicularis oris muscle was functioning at its maximum, but was more apparent when the upper lip was stretched by the action of the zygomaticus, risorius, triangularis and buccinator muscles. The deformity is not hypertrophy, as suggested by some authors, but is a

Fig. 1.—Left: Typical double upper lip showing redundant mucosa which gives effect of two vermilion portions of lip. Right: Postoperative appearance of patient after excision of redundant tissue after method shown in Figure 3

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Fig. 2.—Left: Double lower lip. This deformity is less common than double upper lip. Right: Postoperative appearance of patient at left who also had double upper lip consisting of redundant tissue on only one side

true congenital deformity. It is a developmental anomaly probably present at birth, although our patients did not notice the deformity until after the eruption of the teeth. The deformity causes no functional difficulty but is simply a defect of cosmetic and psychologic importance to the patient. Most patients are quite embarrassed about the deformity and attempt to suppress their smile or hold a hand over the mouth when smiling or laughing. Some develop inferiority and personality complexes as a result of the defect. Cosmetic correction is the principal reason for surgical intervention. The deformity is highly conspicuous and may interfere with the social and economic status of the patient.

Here is a typical pathologic report on one of our patients whose redundant tissue was excised from the upper lip:

"Moderate papillomatous hyperplasia of the submucosa and stratified squamous mucosa. While moderately vascular, it is not a hemangioma or lymphangioma. A large number of mucous glands are seen. No malignancy."

The condition lends itself readily to surgical treatment and can be corrected under local anesthesia as an office procedure (Fig. 3). The local anesthetic is best administered outside the immediate operative field so that the tissues will not be distorted. This is possible in the upper lip by a bilateral injection of the infra-orbital nerve and in the lower lip by bilateral inferior alveolar nerve block anesthesia or by bilateral mental injections. The patient is asked to smile or to move the lip in such a way as to make the redundant tissue most conspicuous. The redundant tissue is grasped with small mosquito hemostats along the entire extent of the deformity. Slight traction is placed on the hemostats by an assistant, and the redundant tissue is excised across the entire width of the lip or across the extent of the deformity along a line represented by the ends of the hemostats. After excision of the mucous membrane along with the submucous tissue, several gland structures that must be removed to reduce the deformity completely may be found

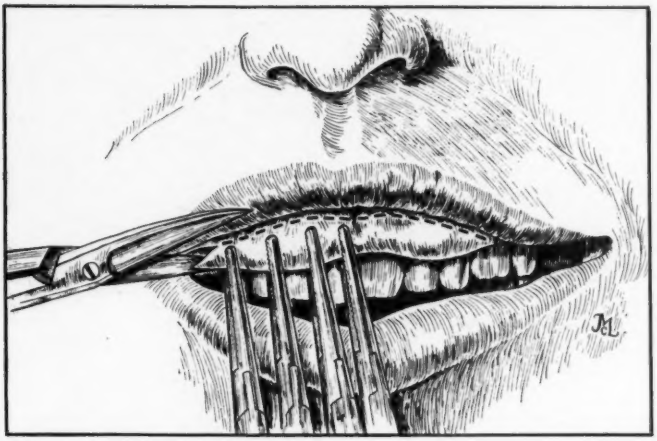

Fig. 3.—The lip is stretched to show the deformity at its maximum. The tissue is then grasped with mosquito hemostats. It is best to grasp all redundant tissue with hemostats before the operation is performed. The hemostats in this case should extend across the entire deformity

within the wound. The adjacent margin of the mucous membrane is undermined generously for at least 1 cm. It is not advisable to undermine the vermilion margin of the incision. Hemostasis is important and should be complete. The margins of the excised area are approximated with fine black silk or cotton sutures. The procedure is the same for deformities of the upper or lower lip.

Care must be taken not to excise too much mucosa at the midportion of the lip, as the lateral portions of the redundant tissue are usually greater in amount than the tissue at the midportion. One author has suggested excision of elliptic shaped sections of tissue on each side of the midline in the horizontal direction with excision of a vertical section from the midline. This might be necessary in some instances, but in our cases the excision usually has been made across the entire width of the lip. In one patient the redundant tissue was present on only one side of the upper lip.

Another author has suggested an incision just above the gingival labial sulcus across the entire width of the lip with extensive undermining of the mucosa down to the lip margin. The mucosa is then retracted upward, the excess is excised, and the wound is sutured along the line of excision. This operation does not seem to be the one of choice, inasmuch as there is no provision for the excision of excessive underlying tissues from the submucosal region.

The postoperative course is marked by only a small amount of postoperative edema which subsides in three or four days, after which the sutures are removed.—*University Hospital.*

STOMATITIS AFTER ADMINISTRATION OF PENICILLIN

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Professor Fleming's discovery that most of the common bacteria in the mouth are penicillin-sensitive[1] seemed to promise a fruitful field for the application of penicillin to oral disease. The search for painless and more convenient methods for its therapeutic administration has resulted in clinical trials with various topical applications including ointments, lozenges, solutions, powders for insufflation, aerosal solutions for inhalation and tablets for ingestion. Treatment by all of these methods, while maintaining a sufficient concentration of penicillin at the site of the oral lesions for brief periods of time, involves intimate contact with the mucosal structures of the mouth. Cheilitis, stomatitis venenata and glossitis are among the complications encountered with the more indiscriminate use of penicillin by mouth. As pointed out by Kleinfield,[2] and corroborated by our experiences, the occurrence of ulcerative lesions in the mouth during the course of treatment with penicillin might lead the attending physician or dentist to increase the amount given in the belief that a more adequate dosage was indicated. Such a procedure might have serious consequences.

The recorded incidence, symptoms and types of allergic or toxic reactions associated with oral administration of penicillin have varied widely. Symptoms observed include soreness of the throat and tongue, extreme dryness of the lips, burning sensations throughout the mouth, impaired taste, sensitivity to hot foods, exfoliative lesions and perleche-like fissures at the labial commissures. Wright and Rule[3] have stated that the severity of the reaction may vary with the salt used. They reported thirteen instances, or 9 per cent, of toxic reactions among 151 patients treated with sodium penicillin lozenges. The reactions which developed were mild, of short duration and consisted of glossitis, papules on the tongue and soft palate, sore throat and slight nausea as well as stomatitis. These symptoms persisted from one to six days whereas, with calcium penicillin, the symptoms were more severe and persisted for as long as fifty-seven days. After the use of calcium salt in the lozenges, six reactions, or 16 per cent, occurred in thirty-eight patients treated. Goldman[4] reported a case in which cheilitis developed in a patient after use of a solution of sodium penicillin as a mouthwash. Goldman and Farrington[5] reported two cases of stomatitis and glossitis resulting from the oral administration of calcium penicillin tablets. They also have described their experiences in contact testing the buccal mucous membrane

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2. Kleinfield, L., Sequellae Following Oral and Topical Use of Penicillin. *N. Y. S. J. Med.* 46:915 (April 15) 1946.

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with penicillin.[6] Our own experiences in a small series of twenty-eight patients with various diseases of the skin or mucous membranes, selected for treatment with penicillin by mouth, resulted in four instances, or 14 per cent, of stomatitis or glossitis when lozenges or tablets of two commercial brands of calcium penicillin were used.

As the oral use of penicillin becomes more frequent and indiscriminate, it becomes important that physicians, oral surgeons and dentists appreciate the oral manifestations and different types of hypersensitivity or toxic reactions which may be encountered.

Stigmata suggestive of vitamin deficiency may be confused with stomatitis venenata, fungus infections of the mouth, such as are seen with Aspergillus nigricans, or with the effects of mouthwashes containing irritants or coloring matter as well as penicillin. The realization that changes in the tongue are a consistent and reliable indication of certain deficiency states has led to many attempts, such as the recent one of DiPalma,[7] to place observations of the tongue on a measurable basis by recording changes in its surface. It is obvious, however, that such changes as edema, redness, congestion and hypertrophy of the papillae may occur either in avitaminosis or from the local effect of penicillin or other drugs in cases of hypersensitivity.

Until the recent development of suitable technics, direct testing of the buccal mucous membranes and attempts to correlate some causes of stomatitis with hypersensitivity had been avoided either because of the inaccessibility of these membranes or because of their insensitiveness to physical or chemical stimuli which ordinarily do not affect the skin. During our experiences with the oral treatment of diseases with penicillin, however, it became apparent that the determination of cutaneous hypersensitivity alone was an inadequate criterion of the sensitivity of the mucous membrane. Stomatitis occurs independently of dermatitis. We also have seen allergic, bullous, ulcerative, inflammatory oral lesions complicating a severe exfoliative dermatitis caused by penicillin.[8] Various types of dermatitis may follow or accompany oral administration of penicillin in the absence of stomatitis. As the need for more information concerning the nature and properties of the buccal mucosa as a shock tissue in penicillin hypersensitivity becomes more urgent, increasing use is being made of the original technic of Goldman and Goldman[9] or its modifications[10] for contact testing in suspected cases of stomatitis venenata caused by penicillin. It is our feeling, however, that in actual clinical practice proved cases of stomatitis caused by penicillin must be rare when one considers the frequent oral and topical use of this antibiotic. The high incidence encountered by us was more apparent than real, as three of our patients were given penicillin orally only after they had shown epidermal evidence of penicillin hypersensitivity. In the case of these three patients we felt that the buccal mucosa shared in a generalized cutaneous hypersensitivity to penicillin. The stomatitis was explosive, coming on after two days to three months of continuous intensive oral treatment with penicillin. Two of these patients were elderly, but we have shown in a previous report that patients of advanced age may

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show quite severe reactions to penicillin.[11] Pain or tenderness of the tongue was at times a prominent symptom, but in no case were significant alterations of the lingual papillae noted. The inflammatory reaction was symmetrical and diffuse. The buccal mucosa and tongue were fiery red and edematous but the entire process receded rapidly and disappeared in two to six days after administration of penicillin was discontinued.

An increasing number of case reports is accumulating in the recent British medical literature, citing evidence of nicotinic acid deficiency associated with oral treatment with penicillin. Bedford[12] has reported two cases in which melanoglossia complicated the ingestion of penicillin tablets. Three additional cases are reported by Ellinger and Shattock[13] who observed evidence of generalized nicotinic acid deficiency after oral administration of penicillin. Since it had been established that up to two-thirds of orally administered penicillin may reach the colon unaltered, it was postulated that penicillin given by mouth could produce a nicotinamide deficiency with lingual manifestations by its action on the intestinal flora or enzyme systems. All symptoms and signs of avitaminosis receded rapidly after nicotinamide was administered parenterally. A later report correlates a depression of the urinary output of nicotinamide methochloride with ingestion of penicillin.[14] Experimentally, we were able to duplicate in one patient the lingual findings cited in the British reports, but only after a five-day period of continuous contact of calcium penicillin lozenges with the tongue. In our opinion, the changes observed were probably caused, at least in part, by a local effect of the antibiotic.

Vilter and Vilter,[15] as well as other observers of our case, concur in this opinion. The black color did not appear to be a bacterial or fungus film but rather an intra-epithelial pigmentation which could not be rubbed off. As in Bedford's patients, the surface of the tongue was covered with a dark brown to blackish fur, while the edges and tips remained clean. The coat was thickest posterior to the circumvallate papillae on the median sulcus anteriorly. Over the posterior surface the color was darkest, almost black, had a moth-eaten, velvety appearance and was covered with a brown detritus which in our case could not be removed by rubbing with gauze or a towel.

The fact that, in the three patients cited by Bedford and in our one patient, penicillin was in contact with the tongue for a long period of time seems significant. Numerous other causes for blackish discoloration have been described and should be ruled out before lingual pigmentary disturbances are ascribed to penicillin. Black hairy tongue, for example, has long been recognized as a congenital abnormality which develops in later life. Pseudo black tongue may originate from local irritants. Oppenheim[16] observed in 1917 that black hairy tongue frequently developed in patients receiving prophylactic care of the mouth by the application of tincture of Krameria (tincture of Rathania, a member of the tannic acid group of remedies). Andrews[17] has stated that the color is caused by changes in the horny cells analogous to those changes which are seen in certain types of hyperkeratosis of the cutaneous

11. Farrington, J., Cutaneous Hypersensitivity Reactions to Penicillin in the Aged. *Geriatrics* 2:2 (March-April) 1947.
12. Bedford, P. D., Black Tongue and Oral Penicillin. *Brit. M. J.* 2:63 (July 13) 1946.
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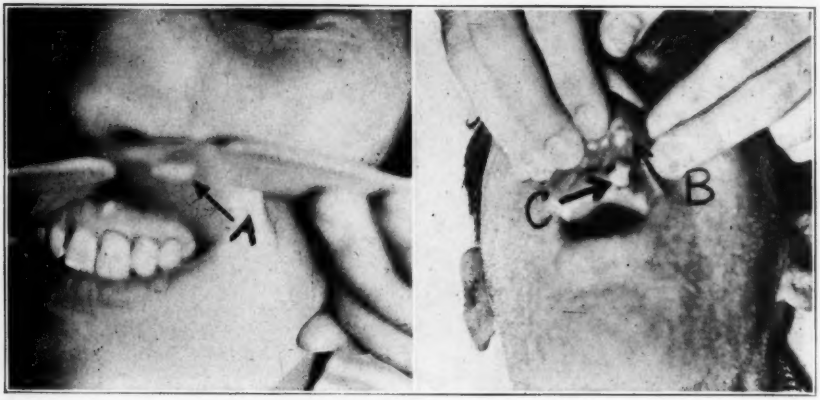

A, Positive contact reaction of buccal mucosal surface of upper lip of young woman hypersensitive to nickel. Note edema and vesiculation of mucosal surface. B, Positive contact reaction of buccal mucosal surface of upper lip of elderly man hypersensitive to penicillin. Note similarity of reactions manifested by edema and vesiculation of mucosal surface. C, Small soft rubber cup used for contact testing of buccal mucosa in elderly people with artificial dentures. Base of cup is cemented to denture with collodion. Small quantities of penicillin are placed on mucosal surface of cup. Contact with testing material may thus be maintained safely from 24 to 48 hours. To remove testing cup, the collodion is dissolved with ether

surface or by pigment from substances taken into the mouth. This is substantiated by Eates[18] who has recently reported a case of black tongue occurring in a patient after the ingestion of hard-boiled eggs. Presumably, this discoloration resulted from the formation and deposition of a sulfide on the tongue.

The duration of potential hypersensitivity reactions to oral administration of penicillin has not been determined. The local effect causing the darkening of the tongue is still under investigation and will be reported at a later date. There was no history from our patients of a vitamin deficient diet but nicotinic acid levels in blood or urine were not determined. No additional signs common to human nicotinic acid deficiencies were observed. For each of our patients we established a correlation between penicillin stomatitis and a positive reaction of the buccal mucosa to contact testing with the antibiotic. We feel that sufficient proof is offered to classify these reactions as examples of true allergic responses to penicillin rather than as manifestations of avitaminosis or other specific constitutional disturbances. Penicillin stomatitis venenata is similar to stomatitis caused by other contactants (see illustration). Unless the disease process, either local or general, gives well defined indication for the oral use of penicillin, this antibiotic should be avoided or administered with circumspection. This is especially true for all patients showing vascular or epidermal evidence of penicillin sensitivity. The reason for the apparently greater susceptibility of the face and mouth to sensitivity reactions from contact with penicillin as compared to other body regions and mucosal structures is not clear. Pierce,[19] for example, has used vaginal suppositories, containing 300,000 units of penicillin, for over 500 patients immediately after delivery, without encountering a single toxic or allergic reaction. This is in marked contrast to the relatively high incidence of hypersensitivity or toxic reactions reported after oral administration of the antibiotic.

18. Eates, A. R., Black Tongue After Eggs. *Brit. M. J.* 2:38 (July 27) 1946.
19. Pierce, R. R., (Cincinnati), Personal communication to the authors.

CONCLUSIONS

1. The reported incidence, symptoms and types of allergic reactions to oral administration of penicillin have varied widely but have included cheilitis, stomatitis venenata and glossitis. Case reports are accumulating in the British literature describing black tongue and other evidence of nicotinic acid deficiency associated with treatment with penicillin by mouth. All other causes for stomatitis and lingual discoloration should be ruled out before ascribing these changes to penicillin.

2. Penicillin stomatitis venenata is similar to stomatitis caused by other contactants. Suitable technics have been described and should be employed in contact testing the buccal mucosa before treatment is instituted or for differential diagnosis of the various types of stomatitis.

3. Evidence of avitaminosis and the apparent susceptibility of the mouth and face to hypersensitivity reactions from contact with penicillin should be investigated more thoroughly.—*Duke Hospital.*

It is a great folly to wish to be wise all alone.—Francois de la Rochefoucauld.

Talent is developed in solitude; but character in the streams of the world.—Goethe.

SOLITARY CENTRAL GIANT-CELL TUMOR OF THE JAW BONES

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Solitary central giant-cell tumors of the jaw bones are comparatively rare. The six reported here comprise the number found among the thousands of dental patients who have come under my observation in over a quarter of a century.

Much is still unknown about the nature of the giant-cell tumor. Even competent pathologists are not in accord as to its pathogenesis or pathologic implication. Lubarsch[1] and Konjetzny[2] held that giant-cell tumors are not neoplasms in the true sense but that they are resorptive inflammatory lesions which develop at the site of hemorrhage. Geschickter[3] expressed the opinion that they represent merely hypertrophy and hyperplasia of osteoclasts left at a site of endochondral ossification. On the other hand, Jaffe and associates[4] wrote that they do represent genuine neoplasms. These authors felt that, in the evaluation of the giant-cell tumor, too much emphasis had been placed upon the giant cells and not enough on the stromal cells which they interpret as the cells determining the character of the tumor.

The concept of the lesion favored by Jaffe and associates is in line with the clinical findings and the life history of these growths, since in all respects they behave as true neoplasms. They appear to have an autonomous growth, they invade and destroy the surrounding hard and soft tissues, infiltrate or destroy nerve trunks in their path and often recur if not completely removed. Furthermore, some growths designated as giant-cell tumors exhibit aggressive characteristics and may even undergo malignant transformation. It should be noted, however, that Jaffe's discussion of giant-cell tumors did not include the giant-cell tumor of jaw bones.

Because they are central giant-cell tumors, the growths considered here are not to be identified with surface epuli, which are rather common and present several histogenetic, histologic and pathologic varieties themselves. The epuli are frequently associated with some local trauma or irritation. They are not locally invasive and, at most, cause only surface destruction of the immediately involved soft tissues or surface erosion of the subjacent bone. The so-called brown or giant-cell tumor which so frequently develops in the jaw in cases of hyperparathyroidism of long standing is strictly excluded from the category of solitary central giant-cell tumor. Nevertheless, Hammer[5] stated that his findings lead him to affirm that there are no recognizable morphologic distinctions between giant-cell epuli and central giant-cell tumors. He maintains that the histologic elements of the two forms of these growths are identical from the standpoint of pathology, morphology and pathogenesis and that the only differences lie in the site of their occurrence, the mode of their appearance and their clinical development. However, this opinion is contradicted by one of Hammer's own cases.

Professor of oral surgery, Columbia University, New York. From the Division of Oral Surgery, School of Dental and Oral Surgery, Faculty of Medicine, Columbia University, and the Oral Surgery Service of the Hospital for Joint Disease, New York.

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4. Jaffe, H. L.; Lichtenstein, Louis, and Portis, R. B., Giant-Cell Tumors of Bone. *Arch. Path.* 30:993 (November) 1940.
5. Hammer, H., Beitrage zur Histologie der Riesenzellergeschwulste der Kiefer. *Vierteljahrsschrift f. Zahnheilk.* 46:505, 1930.

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One may reasonably surmise that the tumors in question originate in a central nidus and that, with increased growth, they destroy the adjoining tissues, following the path of least resistance without provoking any defensive limitations or encapsulations such as one sees in cysts. They show a tendency to infiltrate the bone and thus form smaller and larger cavities and bays by resorption. Quite frequently the cortical bone is broken down until only a thin shell of this tissue remains. In some cases the bone was completely lacking at some points and the growth was covered by the mucoperiosteum alone. In one case the original bone was destroyed completely and at the same time new bone was deposited. When more yielding regions are reached, such as a highly thinned out portion of bone or the periosteum, they are pushed aside, thereby establishing a swelling or deformity in the tissue surfaces.

Like many other neoplasms, these growths develop unobtrusively and insidiously until a fairly advanced stage has been reached. In some instances they are discovered only in the routine roentgenographic examination of the jaws or teeth. In three cases in which the growth occurred in the mental region, the patients' attention was aroused by anesthesia or paresthesia in the area of distribution of the mental nerve. This symptom may be considered pathognomonic or strongly suggestive of a neoplasm in differentiation from a cyst, as the latter lesion rarely if ever alters the sensory functions preoperatively. In some instances, the teeth may become loose or dislodged and some may even be exfoliated when the supporting bone becomes destroyed.

In the diagnosis of these lesions, one should guard against two possible errors. These lesions frequently are mistaken for cysts of the jaw bone, or are considered as actually or potentially malignant tumors, and radical measures are adopted where conservatism would bring about a cure. Solitary giant-cell tumors of the jaw bones exhibit, on the whole, less aggressive qualities than giant-cell tumors of long bones.

ROENTGENOGRAPHIC FINDINGS

In many respects it is difficult to differentiate these growths from cysts or malignant growths by roentgenographs alone. Furthermore, the vacuolated roentgenographic appearance is no longer regarded as a pathognomonic sign in their diagnosis. In the series here observed, such vacuolated partitioning was altogether lacking in some instances. It is rather possible that this bubble-like appearance represents the irregular excavations or compartments of the destruction of bone. The pathologic specimens frequently show bony septa projecting quite deeply into the substance of the growth.

Once the diagnosis of a neoplasm is established, treatment should be influenced by the pathologic findings. Dependence also should be placed upon the experience of the pathologist; and the opinion of the roentgen therapist can be of great value when the treatment is being planned. As these lesions are frequently confused with those provoked by hyperparathyroidism, a calcium and phosphorus metabolism evaluation may be indicated.

CASE 1

The patient, a man aged 27, was a school teacher, who, aside from the present complaint, enjoyed good health.

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Fig. 1.—Case 1. Central giant-cell tumor of mandible. Note rarefaction of mandible and displacement of teeth

Fig. 2.—Case 1. Condition about twelve years after complete excision of the growth. Restoration and normal texture of bone are shown

History.—For several months he had been conscious of a swelling in the lower right bicuspid region. He experienced no discomfort beyond a mild periodical paresthesia of the lower lip. After a lapse of time, however, he noted that the two bicuspids became separated and somewhat loose.

Examinations.—There was a swelling which extended from the first molar to the cuspid tooth. The overlying mucous membrane appeared to be normal, but the two bicuspids were loose.

The roentgenogram showed considerable destruction of bone extending from the first molar to the cuspid. A so-called honeycomb appearance of the mandible, frequently believed to be characteristic of central giant-cell growths was also noted (Fig. 1).

Pathologist's Report.—The report on tissue removed at operation was "giant-cell sarcoma of the mandible." The old term sarcoma is used in this connection because the case dates back about twenty-five years.

Course.— When the patient was operated on in the spring of 1922, the complete growth, together with the four involved teeth, was removed. To avoid subsequent fracturing because of the slight amount of remaining bone, a sustaining appliance was made which was worn by the patient for about three months. By that time cicatrization was complete and a degree of osteogenesis had taken place.

Follow-up Examination.—The roentgenogram (Fig. 2) was taken twelve years after the operation. The patient was seen again several years later. He was well, and the tumor had not recurred. The case is so old that photomicrographs of the tissue are not available.

CASE 2

The patient, when first seen on June 1, 1942, was a well developed, well nourished girl, aged 15.

History.—She had been confined to bed with rheumatic fever for four months five and a half years before the present illness. There were no residual symptoms. Her present illness began about three months before as a periodic pain in the left side of the lower jaw and moderate sensitiveness of the bicuspid teeth to thermal changes.

Examinations.—The pain could be induced and accentuated by pressure over the roots of the bicuspids. Upon deep palpation a defect in the bone could be felt, although there were no visible signs of abnormality or asymmetry about the face or jaws. A few months before consulting me, the patient fell while skating. There was no reason to believe, however, that this

Fig. 3.—Case 2. Original roentgenogram taken on May 25, 1942, showing giant-cell tumor of mandible in girl aged 15. Note displacement of lower border of mandible

incident had any bearing upon her complaint, since there was neither bruising nor other evidence of serious traumatism. The painful teeth were in good condition and in good alinement. They were free from caries, contained no fillings and responded normally to electrical tests.

The roentgenogram disclosed a lesion characterized by bone resorption extending from the second bicuspid nearly to the median line (Fig. 3). Although the region was well defined, closer examination failed to disclose clear cut demarcation such as is characteristic of cysts. The lower border of cortical bone appeared thinned out and displaced, describing a slight arc or angulation. These details are of diagnostic importance. No fluid was found on aspiration and only a scant amount of frothy blood was withdrawn.

Pathologic Examination.—The patient was given a local anesthetic, the region was exposed and a portion of the tissue content was excised.

The pathologist reported that sections showed the lesion to be composed of a proliferation of fibroblasts, osteoid and, scattered at intervals through these tissues, multinucleated giant cells of the foreign body or osteoclast type. There was no evidence of malignancy (Fig. 4). The picture was characteristic of the giant-cell form of osteitis fibrosa, which may represent a solitary lesion, or one of the multiple bone lesions of hyperparathyroidism. Diagnosis was osteitis fibrosa (giant-cell type) of the mandible.

Further Examinations and Treatment.—The patient was given a complete physical examination. A complete blood chemistry test was made and further skeletal roentgenograms were taken. Results of all these examinations were negative.

The patient was given ten roentgen treatments over a period of about two weeks. The total dose was 1,500 r.

Course.—Successive roentgenograms, the latest taken on September 13, 1945, showed that the region had filled in with new bone (Fig. 5). No change was observed in the teeth over the affected region nor in the soft tissues which were exposed to roentgen treatment. The patient was comfortable, and the previous sensitiveness of the teeth had disappeared.

CASE 3

The patient was a well developed white woman, aged 24. She consulted me because of increasing prominence of her lower jaw. Although not too robust, she had no other complaints

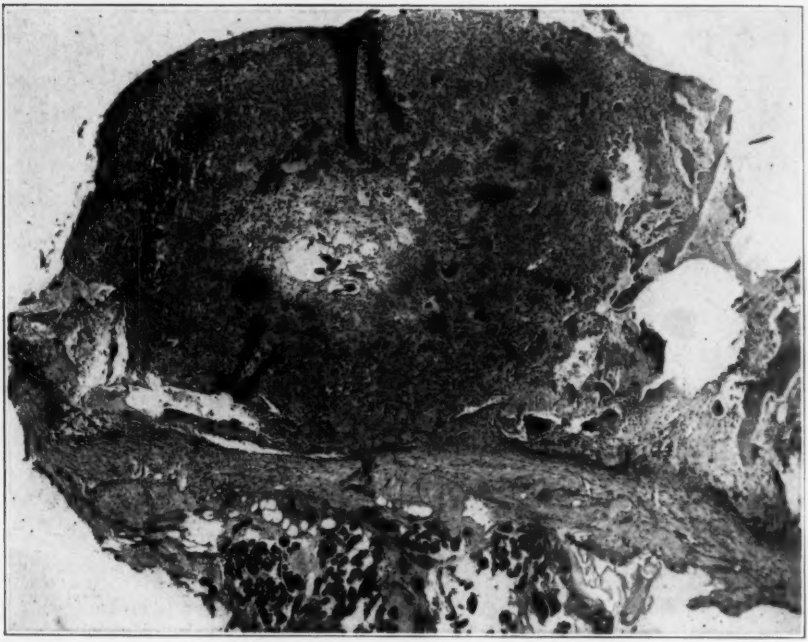

Fig. 4.—Case 2. Low power photomicrograph of specimen taken at biopsy, showing complete destruction of cortex at one point, and some fibers of striated muscle attached to periosteum

Fig. 5.—Case 2. Condition on April 20, 1945, three years after roentgenotherapy. Note filling in of cavity with normal bone and correction of outline of lower border of mandible

Fig. 6.—Case 3. Prominent protrusion of chin with its displacement toward the opposite side, caused by central giant-cell tumor shown in Figure 7

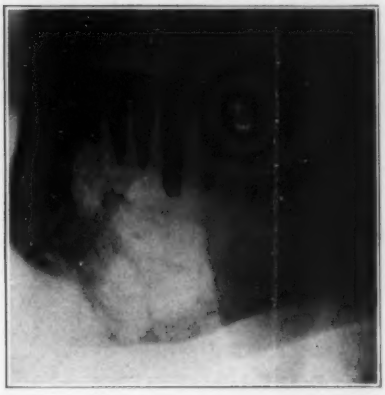

Fig. 7.—Case 3. Extensive destruction of bone is shown. Note that bone was completely destroyed along lower border, and new bone was deposited

which could be associated with the condition of her jaw. Therefore, the duration of the lesion could not be ascertained (Fig. 6).

History.—The patient stated that in November, 1944, she went to a dentist for treatment. The teeth showed general neglect, a number of them had been lost, and those within the affected area were loose.

Examinations.—Examination showed that the chin protruded strongly and was deflected towards the sound left side. Intra-orally there was a pronounced swelling. A difference in the sensitivity of the two sides of the lip was noted, but only after attention was called to it. The skin and the oral mucous membrane showed no signs of inflammation and the soft tissues overlying the lesion glided smoothly and normally over the swelling.

Roentgenographic examination showed a region of bone destruction which extended from the sound first molar beyond the median line. There was protrusion of the bone at the lower border. The three caries free teeth directly within the abnormal region had stunted or resorbed root ends. A roentgenogram showed that the bone beyond the abnormal region lacked the pattern of normal calcification. The outer plate of bone on the labial side was extremely thin and in some places was lacking altogether (Fig. 7). Roentgenograms of the rest of the skeleton were negative.

Pathologic Examination.—As a diagnostic measure the lesion was aspirated to determine its nature, but no cystic fluid was found. The patient was given a local anesthetic, a portion of the swelling was exposed intra-orally and a section of tissue 1½ by 1 cm. was excised. Clinically this tissue was similar to what was seen in other central giant-cell tumors of the jaw. Though not hard, it was compact and somewhat bluish in appearance.

The pathologist reported that paraffin sections of the biopsy specimen proved the lesion to be a typical giant-cell tumor. It was composed of a loose stroma containing a great number of spindle shaped cells and numerous multinucleated giant cells. The nuclei were piled up irregularly. There were no mitotic figures or other signs of malignancy. At the periphery of the tumor were spicules of well preserved bone, some of which showed atrophy probably following pressure by the growing tumor (Fig. 8).

Discussion.—Complete surgical removal of the growth would have necessitated not only the removal of the teeth but also considerable thinning out and mutilation of the jaw bone. Further-

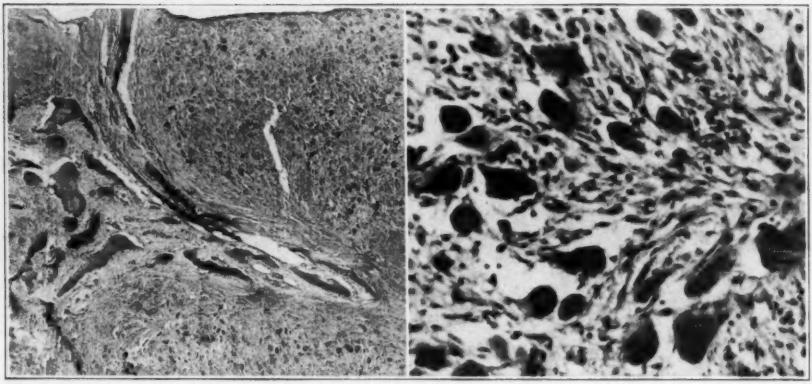

Fig. 8.—Case 3. Left: Low power photomicrograph of biopsy specimen, showing relation of tumor to thinned cortex, and a bony septum extending from it into substance of the growth. Right: High power photomicrograph

more, the extensive bone destruction easily might have led to a fracture. With the scanty remainder of bone there was little hope for union or bone regeneration. In view of the success attained with roentgenotherapy in other cases, this modality of treatment was prescribed. At present, less than a year after the institution of treatment, it is still too early to report on the final results.

CASE 4

The patient was a white woman, aged 40, in good general health and with no history of previous ailments.

History.—In April 1938, she first experienced numbness in the right side of her lower jaw and lip. This partial anesthesia extended from the mental region to the median line.

Examination.—Roentgenograms showed no pathologic condition, and the patient was assured that the numbness would probably disappear. The affection persisted, however, and two months later, in June, a roentgenogram of the affected side of the mandible (Fig. 9), disclosed a region of bone destruction extending from the first molar to the median line. The two bicuspids were devitalized teeth, the first bearing a pivot tooth. The first molar contained several large fillings but was vital. Clinically, the buccal bone over the area was destroyed completely. A part of the lingual plate and the lower compact border of the bone were intact. Diagnosis of a cyst was made. These growths are common in the jaws, especially in the presence of devitalized teeth.

Operation.—In the early part of July 1938, an operation was performed by another surgeon who was under the impression that the lesion was a cyst. The two bicuspids were removed. The nature and extent of the operation upon the bone lesion are not known to me. The pathologist's verbal report, obtained later, was giant-cell epulis. The growth was lodged completely within the bone, however, and had no communication with the external surfaces. The diagnosis was based, in all probability, upon the presence of giant cells and upon the fact that the lesion came from the oral cavity, where the giant-cell epulis is common.

Course and Second Operation.—About three months later, in October, the patient again experienced a sense of discomfort and felt, with her finger, that the swelling had recurred. A second operation was performed during which the remaining molar, although outside the lesion, was also removed. Late in December the swelling recurred again. The numbness of the lip, which had abated, became more pronounced than before.

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Fig. 9.—Case 4. Giant-cell tumor as first seen on June 22, 1938. Note irregular outline of region and presence of devitalized teeth which may be excluded as a cause

Fig. 10.—Case 4. Recurrence of tumor eight months later, after two operations had been performed by another surgeon

Examination.—I saw the patient for the first time on February 8, 1939. The swelling, measuring 3½ cm. vertically and 2½ cm. horizontally, extended from the first molar to the cuspid and was covered with normal mucous membrane. It was compressible but not fluctuant. The bone had been destroyed on both the buccal and lingual sides. A roentgenogram showed the appearance of the lesion after the teeth in its vicinity had been removed (Fig. 10). The lesion appeared more extensive than in the original roentgenogram.

Discussion.—The history of the case and two recurrences of the growth in less than six months' time were unfavorable. Diagnosis, made by the pathologist, of a giant-cell epulis, although obviously erroneous, was nevertheless reassuring. The pertinent question was whether incomplete removal or malignancy was responsible for the recurrences. Because some benign appearing giant-cell tumors in other bones are known to have become aggressive and malignant, the need for a re-examination of the structure of the neoplasm was obvious.

Pathologic Examination.—On February 10, 1939, the patient was given a local anesthetic and a portion of the growth was exposed by raising the mucous membrane. The bone cavity was filled firmly with well organized neoplastic tissue of bluish appearance which may have been caused by hemorrhagic infiltration. No hemorrhage was caused by injection of the local anesthetic, as nerve blocking was used.

The pathologist reported that the specimen consisted of small bits of tissue which were dark red, soft and friable. Tissue sections showed extensive free hemorrhage throughout the tissue and considerable blood pigment within the cells and lying free in the tissues. The pigment was present also within giant cells which were scattered throughout the section, and the giant cells were supported within loose spindle cells and connective tissue. The pathologist's opinion was that the cytologic appearance of the tissue submitted was not characteristic of genuine giant-cell tumor, though its appearance was not incompatible with the presence of giant-cell tumor in the affected tissue remaining in the mandible. In any event, he concluded that despite recurrence of the lesion it was entirely benign.

Third Operation.—The patient was given a general anesthetic and the growth was removed on March 15, 1939. The neoplasm was freely exposed intra-orally and was excised with curets and rongeur forceps until healthy appearing bone was reached. The cavity was swabbed out with a 10 per cent solution of zinc chloride and the wound was closed with interrupted sutures, except for a gap left for dressings. The specimen was divided into two parts and submitted to two pathologists for independent opinions.

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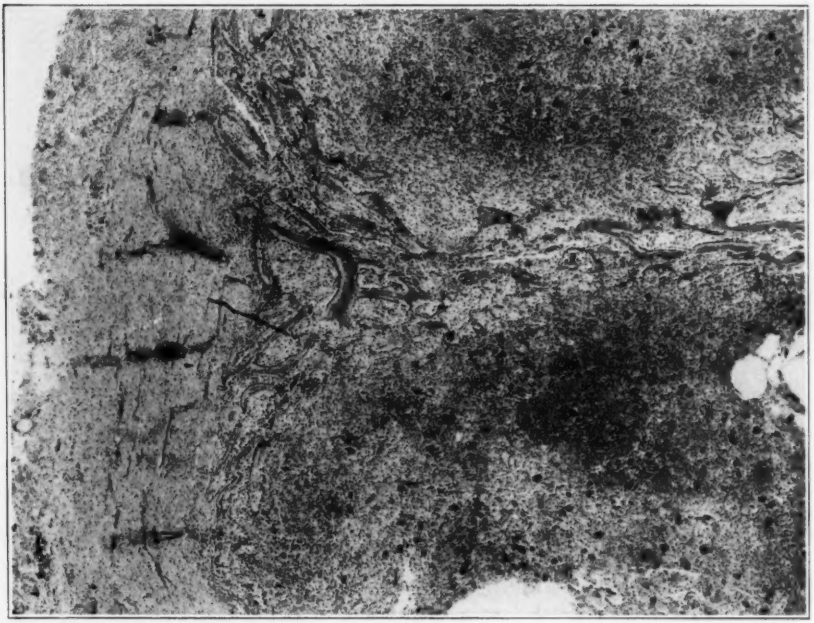

Fig. 11.—Case 4. Photomicrograph of biopsy specimen taken before third and final operation, showing thinned out periosteum and bony septum within tumor mass

Pathologic Report.—One pathologist reported that the tumor was composed of spindle cells arranged in irregular and interlacing strands. There were numerous giant cells with three to twelve round and oval nuclei. Mitotic figures were rare, and there was considerable hemorrhage. Diagnosis was giant-cell tumor of the mandible.

The other reported that sections showed a benign lesion in which there was considerable hemorrhage, giant-cell reaction and a connective tissue stroma which was undergoing osteoid and osseous metaplasia. He considered the lesion entirely benign but hesitated to label it as a genuine giant-cell tumor such as one sees in long bones (Fig. 11).

Examinations.—As the tissue was clinically suggestive of brown tumor of hyperparathyroidism the patient was given a complete physical examination and a blood chemistry test. Roentgenograms were taken of the hands, head and forearms. Results of all these examinations proved negative.

Course.—Recovery was uneventful. The cavity became obliterated, the defective area in the mandible reossified and the patient was dismissed on May 22, 1939. Repeated follow-up roentgenograms are reassuring. They show that ossification is complete (Fig. 12). Sensation in the lip has almost completely returned.

Comment.—There are several facts to be considered in the evaluation of this case. (1) The first symptom was a sense of numbness of the lip and mandible from the mental foramen to the median line. Together with an osteolytic bone lesion, this impairment of sensory function is often characteristic of a neoplasm but not necessarily of malignancy. (2) The two bicuspids within the area were devitalized and infected. Infected teeth are not, as a rule, competent causes for neoplasms, excepting cysts, and the possibility of their etiologic relationship in this

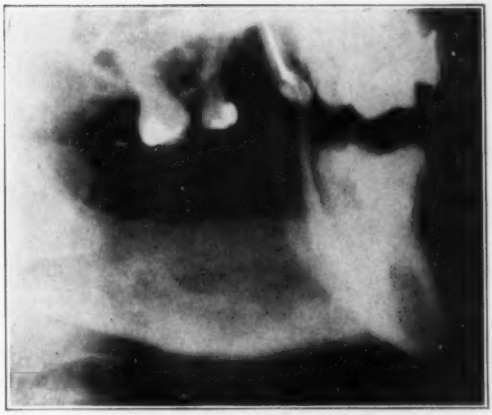

Fig. 12.—Case 4. Appearance of jaw in March 1944, five years after last operation. Note complete filling in of cavity with new bone which appears to be constant, as shown by roentgenograms taken in later years

case may be disregarded. (3) The first pathologist, who diagnosed the growth as a giant-cell epulis, probably lacked information about the clinical features of the case. This lack is a frequent source of error. The epulis is always a surface growth.

CASE 5

The patient was a well developed, alert, healthy girl, aged 10. The previous history was essentially negative. The patient was seen first on November 1, 1939.

History.—She fell about a year prior to this date, striking and loosening her upper left central and lateral incisors. For several weeks after the accident these teeth were tested for vitality by her dentist and seemed to be subnormal. The roentgenograms which were taken at that time were negative. A swelling of the face in the region of the affected incisors had been noted by the parents about two weeks before the patient came for consultation.

Examinations.—Clinically, a diffuse swelling was apparent on the left side of the face at the base of the nose, extending from the median line into the canine fossa. It measured about 4 cm. in diameter externally and rose about 7 mm. above the surface of the normal tissue. The swelling was more pronounced intra-orally than externally, when the two sides of the face were compared, and the nasolabial fold was almost completely obliterated. The lesion was not painful, was easily compressible but not fluctuant and had a consistency suggestive of a soft rubber sponge. The overlying mucous membrane was normal in color and texture. The two incisor teeth were somewhat opaque and loose. Roentgenograms showed what appeared to be a cystic area involving the two traumatized teeth (Fig. 13). The roots of the teeth appeared to be eroded, and about half of their length projected into the lesion. The latter extended to and displaced the floor of the nose and came close to the maxillary sinus.

Discussion.—These findings, with the history of trauma, strongly suggested radicular cyst, which is commonly found under similar circumstances. Some features of this swelling, however, were not typical of these growths. Cysts, as a rule, expand the bone but rarely break through, whereas in this case a large portion of the growth was outside the bone. Upon palpation it was not clear whether the mass contained fluid; however, no fluid was found by aspiration, and only a scant amount of blood. It was decided to operate with the idea that the lesion

Fig. 13.—Case 5. Appearance of central giant-cell tumor in upper jaw of girl aged 10, on May 19, 1939. Note displacement of floor of nose and lateral displacement of incisor teeth

Fig. 15.—Case 5. Appearance nearly five years later, on September 23, 1943, after roentgen treatment. Note corrected position of teeth and complete obliteration of cavity with new bone

would be removed at once if it proved to be a cyst. If it was diagnosed as neoplasm, biopsy would be made.

Operation.—On November 3, 1939, the patient was given a local anesthetic and the mucoperiosteum was raised from the median line to the lateral incisor. The mass consisted entirely of firm layers of grayish neoplastic tissue, a portion of which was excised for pathologic examination.

Pathologic Examination.—The pathologist reported that sections consisted of a fibrous connective tissue stroma in which there were enormous numbers of giant cells, irregular in outline but with a tendency to be round or oval. Many had irregular processes projecting from the body of the cell. The cytoplasm was acidophilic. The cells varied in size from 27 by 13 microns to 85 by 38 microns, and contained from 4 to 30 nuclei. The nuclei varied only slightly and were vesicular. However, in individual cells, both vesicular and hyperchromatic nuclei were present. A few nuclei contained prominent nucleoli. Adjacent to the giant cells were round and spindle shaped cells having cytoplasmic processes and containing a single nucleus. The connective tissue in most areas was loosely arranged and contained a moderate number of dilated, thin-walled blood vessels. Within the stroma there were a few lymphocytes and a very occasional eosinophilic leukocyte. In one area, described in the gross specimen as yellowish-gray, the fibrous tissue was denser and moderately vascularized, showing no giant cells. Diagnosis was giant-cell tumor (Fig. 14).

Discussion.—On the basis of this report it was not likely that the two incisors could be saved by conservative treatment. Surgical extirpation of the growth would necessitate the removal of these teeth and a large portion of the bone. It was necessary to consider seriously the mutilation which such an operation would entail, especially in the anterior part of the mouth. After consultation roentgenotherapy was prescribed.

Treatment.—Ten roentgen treatments were given, three times a week over a period of

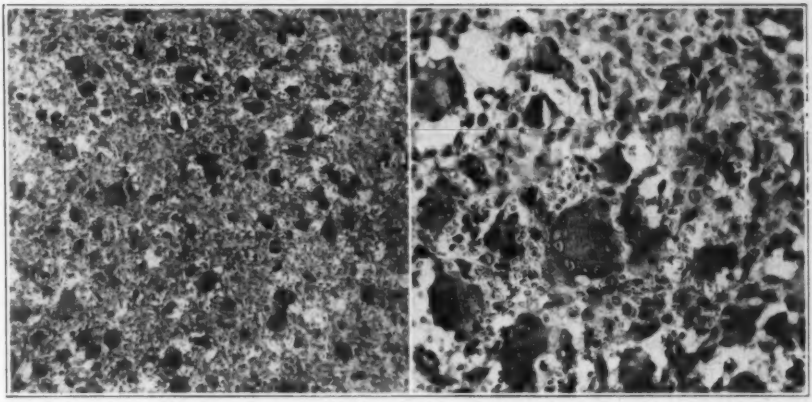

Fig. 14.—Case 5. Low power (left) and high power (right) photomicrographs of specimen taken at biopsy in case diagnosed as giant-cell tumor of maxilla

twenty-two days. A total dose of 2,640 r (measured with back scattering) was delivered in unit doses of 264 r to the skin overlying the anterior part of the left side of the upper jaw.

Course.—The response to this treatment was gratifying. The swelling subsided slowly, shrinking 20 per cent in six weeks after the first treatment, 75 per cent in four months and 90 per cent in five months. Thereafter, the growth slowly and progressively shrank further and became firm and hard.

The teeth became firm and acquired a normal appearance. Roentgenograms taken at intervals showed that the eroded roots assumed a normal outline and a clear-cut periodontal attachment. They responded as vital teeth to tests, though within a somewhat subnormal range. This patient is being examined periodically. Successive roentgenograms taken show complete healing and ossification of the affected area (Fig. 15).

CASE 6

The patient, a well developed young woman, aged 22, came for consultation on June 10, 1936. She was in good health and had required no medical attention through the years, except for occasional minor ailments.

History.—About three months prior to consultation she noticed a partial numbness of the right side of the lower lip, extending throughout the distribution of the mental nerve.

Examinations.—All teeth were present, firm and in good alinement. There were a few small superficial fillings in the molars, but all other teeth, from the bicuspids forward, were normal.

A swelling extended intra-orally from the first molar to the cuspid tooth, anteroposteriorly, and downward from just below the gingivae to close to the lower border of the mandible. The mucous membrane was unbroken and normal in color, and glided smoothly over the swelling, indicating that this membrane was not involved in the pathologic process. Upon palpation the mass felt like a rubber sponge. There was no crepitation, and pressure caused no pain. The bone over a part of the area had been resorbed on both the lingual and buccal sides so that the mass could be moved laterally with digital pressure.

The roentgenogram showed an irregularly outlined region of destruction of bone which appeared to extend forward from the mesial root of the first molar close to the median line (Fig. 16). The mesial root of the first molar and the root ends of the two bicuspids and the cuspid projected into the region of destroyed bone. The root end of the second bicuspid

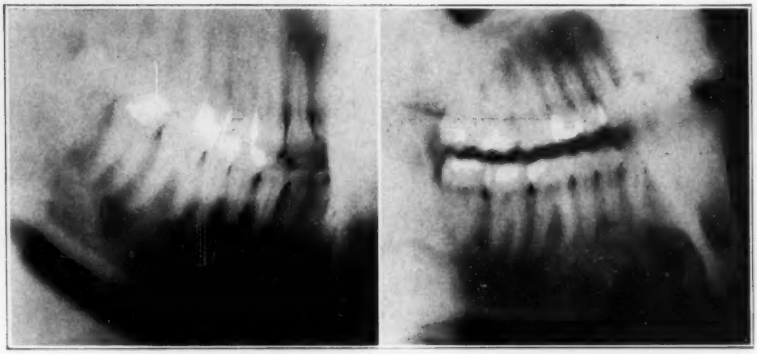

Fig. 16.—Case 6. Left: Giant-cell tumor of mandible as first seen on June 10, 1936. Note irregular outline and bay-like formations in peripheral bone. Stunting of root end of first bicuspid may result from arrested development or resorption caused by the growth. After roentgenotherapy the cavity filled in with new bone which remains constant after nearly ten years. Right: Obliteration of region with new bone

appeared to be resorbed. It was difficult to state whether this defect was caused by resorption or by arrested development. In the roentgenogram the lesion showed excavations and an eroded surface at the periphery. It was not altogether clear-cut as a cyst would be and suggested a possible neoplastic infiltration. The lower border of the cortical bone was intact. The region seemed to be traversed by bony septa. No cystic fluid was found by aspiration, and only a scant amount of frothy blood was withdrawn.

Pathologic Examination.—The patient was given a local anesthetic, the mucous membrane was raised and a block of tissue about 2 cm. in diameter was excised. The wound was closed with interrupted sutures.

The pathologist reported that a section showed a tumor made up of solidly packed spindle shaped fibroblasts and collagen fibers interspersed with a great many multinucleated giant cells of the foreign body type, some of which were vacuolated. There were many capillaries and there had been some small hemorrhages. The cortical bone had been greatly thinned, apparently by pressure, so that in some regions it had only a single trabecula between it and the periosteum. Diagnosis was giant-cell tumor of the mandible (Fig. 17).

Discussion.—Three possible treatments were considered: (1) complete surgical eradication, which would necessitate the removal of six teeth, from the first molar to and including the central incisor, and a considerable portion of bone (such extensive loss of tissue always resulting in a degree of facial deformity and mutilation of the jaw outline); (2) roentgen therapy to be employed after operation; or (3) roentgen therapy which, if successful, would obviate the removal of teeth and bone and the consequent mutilation. After consultation with the pathologist and the roentgen therapist, roentgenotherapy and subsequent periodic check-up were prescribed.

Treatment.—Fourteen roentgen treatments of 200 to 300 r were given at intervals of about three days over a period of two months. The total amount of roentgen treatment (measured with back scattering), was 3,400 r.

Course.—One week after the first treatment the external swelling began to shrink. Three months after the first treatment, it had shrunk to 75 per cent of its former size. Thereafter, the tissue surface returned to normal contour, reaching that state, as judged by palpation, about six months after the first roentgen treatment.

After this treatment, roentgenograms were taken about every six months. The last shown here was taken on April 10, 1945. They disclosed a progressive filling in of the cavity. Practically complete restitution of the bone took place eventually as is shown in Figure 16, a

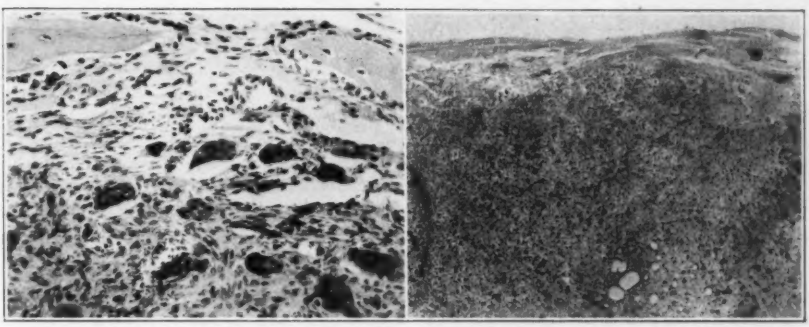

Fig. 17.—Case 6. Left: High power photomicrograph showing details of cellular composition of tumor and thin trabeculae representing all that is left of cortex. Right: Low power photomicrograph

roentgenogram taken six years after institution of treatment. Clinically, too, the swelling has completely disappeared, and the bone surface has resumed a normal outline. The stunted bicuspid has caused no disturbance to date. A further notable result is that normal sensation has returned to the lip.

SUMMARY

Six cases of solitary central giant-cell tumor of the mandible are described. These tumors are relatively rare in this site. On the whole, they are less aggressive than central giant-cell tumors of the long bones. One of the six patients was treated by complete excision of the growth and one by curettage alone, after which the region of affected bone healed permanently.

The other four patients were treated more conservatively. An ample specimen for biopsy was taken to establish the diagnosis. Subsequently, these patients were treated with roentgen therapy, the details of which are given in the individual case reports. In all these five cases, too, the lesion healed and filled in, and there has been no recurrence.

It is to be noted that no deterioration of the teeth or the soft tissues was observed as a result of roentgen therapy.

The paresthesia of the mental region, which occurred in three of the patients with mandibular involvement, disappeared a variable length of time after the lesion healed.—*654 Madison Avenue.*

BILATERAL CONDYLAR FRACTURES

Douglas B. Parker, M.D., D.D.S., New York

REPORT OF CASE

History.—A white woman, aged 33, sustained injuries when she apparently fell asleep while driving her car. The car struck a steel pole and the patient was thrown against the steering column. Her face apparently struck the steering wheel or instrument panel. The patient became unconscious and was not able to give an accurate account of the accident.

Physical Examination.—The patient was admitted to the hospital on May 2, 1942. There was a laceration of the chin with marked swelling and discoloration of the right side of her face. She was unable to bring her teeth into occlusion. Manipulation of the mandible on examination showed abnormal mobility of the right angle with a shifting of the mandible to the right of the midline.

Roentgenographic Examination.—The roentgenogram showed a fracture of the right angle of the mandible and a fracture through the right ramus of the mandible at the neck of the condyle with marked displacement of the entire ramus externally. There was also a fracture of the left ramus at the neck of the condyle with very slight displacement.

Operation.—On May 3, 1942, the patient was anesthetized with Avertin administered by rectum, and the upper and lower labial arches were ligated to the buccal surfaces of the upper and lower teeth with stainless steel wire. The ramus was manipulated into an apparently normal position and the upper and lower teeth were brought into a normal occlusal relationship. Intermaxillary tie wires were applied.

Postoperative Roentgenograms.—X-ray examination of the right side of the mandible showed that the ramus was not in good relationship to the body of the mandible because of external rotation of the ramus.

Comment.—It was felt that reduction of the fracture by interdental fixation between the upper and lower jaws was not adequate in this case to hold the ramus in a normal position, and that other means would be advisable.

Second Operation.—On May 5, 1942, the patient was anesthetized with Avertin by rectum and ether administered intranasally. Stabilization of the ramus and mandible on the right side was accomplished by the use of an external skeletal fixation appliance designed by the operator. It consisted of two vitallium screws held together by a universal joint clamp and a third screw held in a Starrett universal joint clamp from a surface gage (Figs. 1 and 2). These two screws were fastened together in the universal joint clamps by a steel connecting bar. Two small incisions were made through the overlying soft tissue anterior to the fracture at the angle of the jaw, about 1 cm. above the lower border of the mandible. Holes were drilled with a hand drill to permit entrance of the coarse threaded screws used for fixation. Along the posterior fragment the small incision was made over the ramus on the right side. A sharp pointed instrument was introduced and pressure was applied to the ramus in order to manipulate this segment of bone into a more normal anatomic relationship. A drill was introduced into the incision at this point, and a hole was drilled for the coarse threaded vitallium screw that was introduced into the bone. With the posterior fragment held in position, the parts were alined. Tightening of the universal joints on the horizontal bar connecting the two segments stabilized the fragments.

Postreduction Roentgenograms.—Examination of the pictures showed the parts to be in good anatomic relationship with a slight space of a few millimeters separating the ramus from the body segments.

Progress.—The wounds around the three screws were dressed daily with sterile petrolatum gauze. Because the postreduction roentgenogram showed a space between the fragments, the screws on the horizontal bars were loosened and adjusted to bring the parts into closer appo-

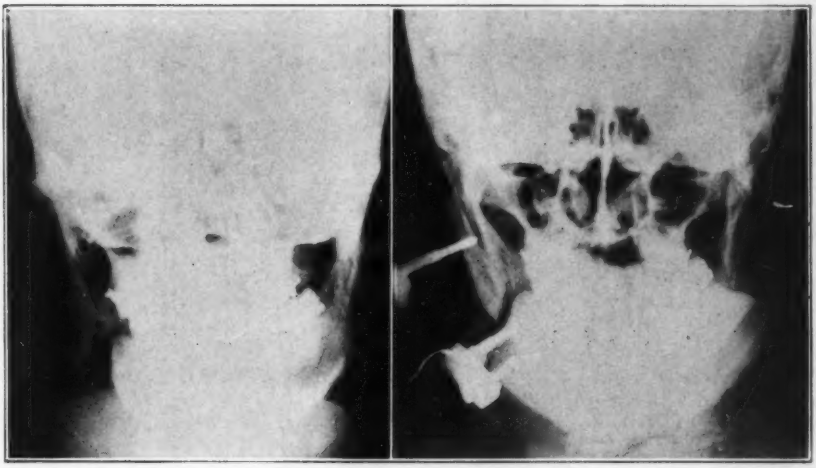

Fig. 1.—Left: Roentgenogram showing marked displacement of right ramus of mandible, persisting after stabilization of mandible with intermaxillary fixation with labial arch bars. Right: Roentgenogram of external skeletal fixation appliance in position

sition. The patient was given routine mouth irrigations after meals for oral cleanliness. The petrolatum gauze dressings on the outside of the face were discontinued after two weeks. There was no infection around the screws until the third week, when there was a slight exudate around the posterior screw, but no destructive process resulted. The patient was discharged from the hospital on June 15, 1942, and was followed up for treatments and observation in the outpatient clinic. External fixation screws were kept in place for eight weeks. Roentgenograms showed good bony union at the end of eight weeks' time, and the patient was able to function well because the teeth were in a good occlusal relationship.

Follow-up.—The patient was seen every three months. There were no untoward results until September 23, 1943, when she returned with a history of severe pain in the left temporomandibular joint during functional mastication. Frequent examinations showed that this condition was becoming steadily worse, causing the patient to resort to the frequent use of narcotics in order to endure the pain. A roentgenogram of the left temporomandibular joint showed a bridge of bone developing across the space in the joint. Immobilization of the jaws by wiring the mandible to the maxilla for three weeks afforded the patient temporary relief, but pain returned on removal of the wires. Partial trismus was progressively developing and it was deemed advisable to perform arthroplasty for relief of the developing ankylosis. The patient was readmitted to the hospital on November 30, 1943.

Third Operation.—On December 1, 1943, the patient was anesthetized with Avertin by rectum and ether administered intranasally. An incision was made on the left side of the face just anterior to the left ear and carried forward horizontally from the ear on the level of the lower border of the zygoma. A vertical incision was made downward from the posterior end of the horizontal incision. Each side of the incision was about 2 cm. in length. Blunt dissection was employed as much as possible to avoid the facial nerve. By retracting the wound, we were able to expose the outer side of the mandible at the condyle. The mandible was chiseled across horizontally about 2 cm. below the head of the condyle which was fused to the temporal bone. The joint surface was likewise chiseled away, and this section of bone involving the head and neck of the condyle was removed. Some of the temporal fascia was interposed into this space and the entire space was packed quite firmly with half-inch iodo-

Fig. 2.—Photograph of fixation appliance in position

form gauze. The masseter muscle and deep fascia were approximated with deep sutures of chromic gut, and the packing was led out through the lower pole of the wound. Skin sutures of dermal silk closed the skin surface except for a small opening through which the packing extruded. A firm dressing was applied to the wound and strapped with adhesive tape, and an external bandage was applied.

Progress.—The patient had considerable postoperative swelling, but the first dressing was not removed for five days. The wound was re-dressed, and a small portion of the iodoform packing was removed on December 6, 1943. The patient was discharged from the hospital on December 8, 1943, to return to the outpatient clinic.

A small portion of the iodoform gauze was removed over a period of about three weeks. The external wound closed spontaneously. No infection was present during the course of these dressings.

Follow-up.—The patient was seen on April 1, 1944. There was no pain, and mandibular function was good although there was a slight shift of the mandible to the left, causing discomfort to the lower left second molar. This tooth had to be removed because of trauma.

Comment.—Although this patient had a fracture of both condylar necks, no specific treatment of these fractures was indicated. Apparently the injury to the articular surfaces of the left temporomandibular joint was sufficient to set up a destructive process with arthritis that caused a productive deposition of bone nearly eighteen months after the original injury. Arthroplasty entirely relieved the excruciating pain, and the patient's jaw function has been restored to normal.—*121 East Sixtieth Street.*

FRACTURE OF THE MANDIBLE WITH NON-UNION AND BONE GRAFT

Douglas B. Parker, M.D., D.D.S., New York

REPORT OF CASE

History.—A man, aged 45, was struck on the left side of his face during an argument in June, 1942. The patient was admitted to a hospital in Pittsburgh, with a fracture of the left side of the body of the mandible. Five days after the injury, the patient had a marked swelling of the left side of his face and some difficulty in swallowing, which necessitated an external incision and drainage. Further drainage ensued and a large sequestrum was removed from the left side of the mandible. The external wound healed. In the meantime, fixation of the mandible to the maxilla was performed for stabilization of the fracture. The patient was discharged with a nonunion of the fractured mandible on the left side. No further treatment was given for nearly a year. He was admitted to a hospital in New York, on June 3, 1944, for treatment of the un-united fracture.

Examination.—The patient had an un-united fracture of the left side of the body of the mandible in the molar region. All posterior teeth of the left side of the lower jaw were missing. There was some degree of fibrous union, but the un-united parts could be moved readily on manipulation. Voluntary movement on the part of the patient caused a considerable degree of motion at the site of the un-united fracture. It was deemed advisable to utilize autogenous bone graft for repair of the un-united fracture.

Operation.—On June 24, 1944, the patient was anesthetized with Pentothal Sodium, administered intravenously. Exposure was made of the right iliac region and an incision was made over the crest of the ileum. The muscle attachments were dissected back by blunt dissection, and a section about 5 cm. in length was exposed. This section of bone was removed with a bone saw, cutting down about 1 cm. from the surface. The horizontal section was made by motor saw. The deep fascia was coapted with chromic gut sutures and the skin wound was closed with black silk sutures. The wound was dressed. The section of bone was wrapped for further use in gauze saturated with physiologic saline solution.

The left side of the face was sterilized with alcohol and Merthiolate and isolated with sterile towels. An incision was made under the left side of the mandible through an old scar resulting from a previous incision. The soft tissue was dissected back, exposing the lower border of the mandible. Extensive scar tissue was found and was dissected from between the un-united parts

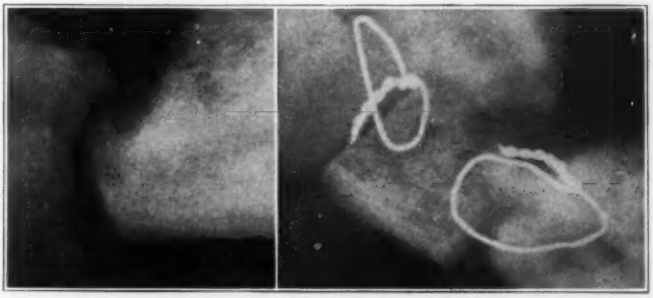

Fig. 1.—Enlarged intra-oral dental roentgenograms taken before (left) and after (right) bone grafting

Fig. 2.—Extra-oral roentgenograms taken before (left) and after (right) bone grafting

of the fracture. The ends of the bone were freshened by removal of their surfaces with chisels and rongeurs. With a power saw, a section of each side of the lower border of the fragments was removed so that a graft could be inlayed into this space. The donor graft, previously removed from the ileum, was cut to fit the defect. It was made slightly longer than the defect so that it could be wedged in place. Four holes were drilled, one in each section of the donor graft and one in each of the ends of the bone fragments, and the graft was wired in place with stainless steel wire (Fig. 1). Small bone chips, made from the remaining section of the donor graft, were packed carefully into the space between the fragments of the fracture. The deep closure was made with chromic gut sutures and the skin was coapted with dermal silk. An external pressure dressing was applied. After the patient recovered from the anesthesia, the mandible was splinted to the maxilla by labial arch bars which had been applied prior to the operation. These were fastened together by tie wires to produce a good occlusal relationship.

Postoperative Roentgenograms.—The graft was in excellent position and the bony parts of the left side of the mandible were in good anatomic relationship (Fig. 2).

Progress.—Sutures in the skin in both the iliac and mandibular regions were removed on the sixth day after operation, and no infection was seen. The patient was given daily mouth irrigations and was kept in the hospital for observation. Postoperative roentgenograms, taken at the end of the seventh week, showed bone calcification in the region. The splints were removed at the end of the eighth week. The patient had a firm bony union which was considered quite satisfactory.—*121 East Sixtieth Street.*

ANTHRAX OF THE ORAL CAVITY

Orville C. Briggs, D.D.S., Fort Wayne, Ind.

REPORT OF CASE

History.—On February 8, 1936, a girl, aged 17, came to my office complaining of a swelling in the roof of her mouth on the left side, accompanied by a dull constant pain. She was a well-developed, rugged girl with no history of serious disease.

Examination.—Clinical examination revealed a clean, well-kept mouth. All teeth were in position and sound with the exception of the upper left second bicuspid which had been repaired with amalgam. There was a moderate swelling, covering the left half of the hard palate, which had arisen suddenly three days before. The patient's dentist had made an incision about one-fourth inch long opposite the second bicuspid. A straw-colored fluid was draining from the opening. The patient's temperature was 100 F. and she looked and felt ill. A smear was made from the drainage material and the patient was referred to a roentgenologist.

Roentgenographic examination of the hard palate and the teeth on the left side revealed thinning out processes in the palate. There was a small rarefied area at the apex of the second bicuspid, and the periodontal membrane surrounding the other teeth in the vicinity was slightly thickened.

Laboratory examination of the smear by a physician and myself demonstrated a few pus cells and organisms commonly found in the mouth. Blood examinations made by the patient's physician were negative for syphilis.

Diagnosis.—Periostitis.

Treatment and Course.—The patient was sent back to her dentist and physician with suggestions that she use hot physiologic salt solution in the mouth and ice on the outside of the face.

On February 14, six days later, the patient's temperature was 99.6 F. and her pulse was 80. The pain had diminished but the swelling was much more pronounced.

Operation.—The patient was anesthetized with nitrous oxide and oxygen, the bicuspid tooth was extracted and more adequate drainage was established. More pus was in evidence than at the previous visit.

Course.—The patient returned home and I did not see her again until February 28, fourteen days later, when it was very apparent that we were dealing with an unusual condition. Her temperature was only 100 F. and she was feeling better generally but the local condition had become much worse.

There was extensive edema on the buccal and labial surfaces as well as in the palate. The teeth were elongated one-half their length on the affected side and seemed to be held only by the soft tissues at the gingiva. The patient was unable to close her mouth.

Pustules with bright red bases had appeared on the mucous surfaces. Some of these were forming vesicles and some were scabbing over and drying up. Upon probing, no resistance was met throughout the thickness of the alveolar process. Dental films made at this time showed no remaining bony structure.

A smear of exudate from one of the vesicles was sent to a pathologist who readily demonstrated anthrax bacillus. Antianthrax serum was ordered immediately and was sent directly to the patient's physician who had been notified of the findings. The serum was administered within six hours after the diagnosis was made.

On March 9, ten days later, the patient was very much improved and came to my office. There was very little swelling and the original lesions were healed. Three vesicles and several scabs remained, many of which, according to the patient, had developed and healed since I had last seen her. The teeth were returning to their normal positions and the jaw seemed firmer. Gentian violet was being used to discourage development of any secondary infection.

When the patient returned on March 19, a few scabs were still in evidence. The swelling was

gone and the teeth were quite firm in the jaws. Roentgenograms showed a condensing process in the jaw. All roentgenograms were sent to the referring dentist and physician and are not available.

In an attempt to find the possible source of the infection, we learned that the patient had purchased a toothbrush at a ten cent store just before the onset of the trouble. The brush probably had been made in Japan and was the most likely source of the causative organisms.—*414 Wayne Pharmacal Building.*

DRIFTING OR MIGRATING TEETH

Joseph P. Wahl, D.D.S., New Orleans, La.

REPORT OF CASE

On October 21, 1943, a girl, aged 14, came to me for an opinion regarding her misplaced, embedded teeth.

History.—Roentgenograms taken in 1940 showed the position of these teeth to be lingual to the mandibular right central incisor and cuspid. The lateral incisor was missing. Roentgenograms taken in 1941 showed that the teeth had moved backward toward the angle of the mandible, although remaining on the lingual side of the bicuspids (Figs. 1, 2 and 3).

Examination.—The patient was healthy looking and apparently had no discomfort from these teeth, although her parents were greatly concerned about them. The teeth did not show in roentgenograms taken in the front views, but another picture made of a region further back in the mouth showed that the teeth had moved to the molar region and were under the bicuspid and molar. After examining the roentgenograms, I consulted with the patient's orthodontist and we decided to have the patient return in about a year for further advice.

Course.—She did not return until July 16, 1945, when further x-ray study was made. These roentgenograms showed that the teeth had moved still further back under the bicuspids and molar and to the buccal side. As no one could tell when or where the teeth would settle permanently, we decided that they should be removed. The patient's parents were advised to that effect and were told of the possible postoperative complications, such as paresthesia of the right side of the lip and the loss of the mandibular right second bicuspid and first molar. The parents consented to the operation.

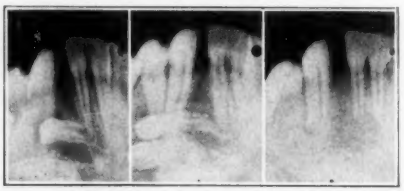

Fig. 1.—Dental roentgenograms of the symphysis region taken in 1940 (left), 1941 (center) and 1943 (right), showing movement of the two embedded teeth. On the right, regeneration of bone is shown in the incisor region originally occupied by the roots of the embedded teeth

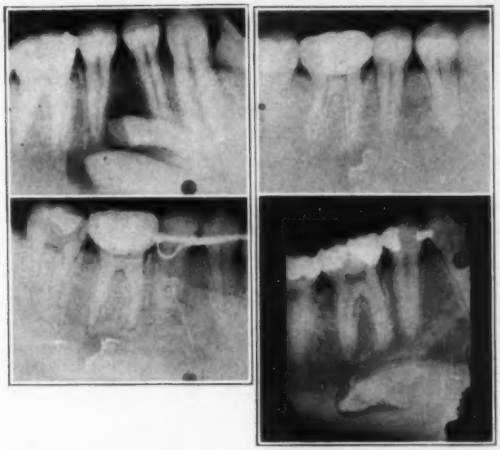

Fig. 2.—Roentgenograms taken in 1941 (upper left), 1943 (upper right), 1945 (lower left) and 1946 (lower right), showing progress in movement of the embedded teeth to a point distal to the first molar

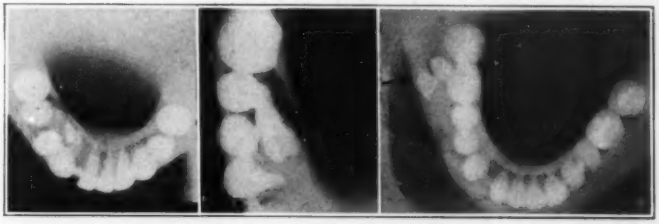

Fig. 3.—Occlusal roentgenograms taken in 1940 (left), 1941 (center) and 1946 (right), showing movement of embedded teeth from lingual to buccal side of first and second molar region

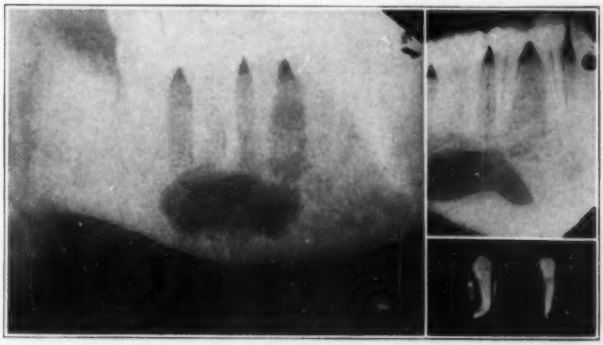

Fig. 4.—Postoperative roentgenograms and photograph of embedded teeth

Operation.—The patient was hospitalized, and on July 31, 1946, was operated on under nitrous oxide and Pentothal Sodium anesthesia. The teeth had moved under the bicuspids and the molar to the buccal side of the mandible, close to the lower border. The operation was performed intra-orally, and the teeth were removed from the buccal side of the mandible near the lower border where they were embedded in the cortical bone.

Outcome.—The patient made an uneventful recovery and did not lose her bicuspid or first molar. There was very little paresthesia of the lip, although I exposed the mental nerve while recovering the curved part of the root of one of the teeth which had fractured. The bicuspid and molar responded normally to the vitality test. Postoperative roentgenograms are shown in Figure 4.

Comment.—Although I investigated all the literature available, I could find no satisfactory explanation for the movement of these teeth. I believe that they could have been removed with less difficulty and with fewer chances for the postoperative complications mentioned if the operation had been performed in 1940 when the child's bone was softer and the teeth were in a more accessible position.—*825 Maison Blanche Building.*

ABSORBABLE OXIDIZED CELLULOSE WITH THROMBIN AS A HEMOSTATIC AGENT IN SURGICAL PROCEDURES. Alfred Uihlein, Theron Clagett, Arnold E. Osterberg and Warren A. Bennett.

Specially prepared absorbable oxidized cellulose, either gauzelike or cotton-like in type, with a solution of thrombin, was tried by various surgeons of the Mayo Clinic as an aid to hemostasis in sixty cases. Results were encouraging. Hemostasis was excellent and immediate in thirty-seven cases and satisfactory in twenty cases. The hemostatic effect of the use of oxidized cellulose seems to depend on the sticky character of the medium when it is saturated with blood. There is a minimum of tissue reaction to its use and it is relatively absorbable. It can be removed from a wound without the secondary bleeding that so frequently occurs after removal of ordinary gauze. Since cellulose is a foreign body, use of a large amount of it in a deep, undrained wound may be unwise. In pathologic studies, no fibers were found in the tissues four and one-half days after the material had been introduced into the wound. The reaction in the tissue was limited to the presence of a few polymorphonuclear cells. The results of the study would seem to justify further clinical trial of absorbable oxidized cellulose, both with and without thrombin. The field of applicability seems wide and uses other than as a hemostatic agent are possible. Its use should not be substituted for careful surgical technic.—*Surg., Gynec. and Obst.,* May 1945.

UMI

SIR WILLIAM OSLER

Stephen Paget, kindliest of philosophers, says that practice is science, but science touched with emotion. The best physician is he who leaves behind him a saucerful of the milk of human kindness. One of the greatest physicians who ever lived, as distinguished for his beautiful courtesy as for his surpassing scientific skill, did not think it belittling to give it in full measure. Sir William Osler never left a sickroom without leaving renewed hope behind him; it was his kindliness as much as his therapeutics that wrought the benediction of healing. His life is a portrait of the perfect combination of scientist and humanist.

We have standardized our hospitals and our medical schools, and our patients are in all respects the better for it; we have standardized our medical and surgical therapeutics and our patients are in many ways better for it. But we are in danger of standardizing ourselves and them and we are the worse for that, for there is a limit which we have about reached. It would profit us and not lessen our scientific efficiency to be more personal and more human in our relationships; to regard as something more than cases and symptom complexes the ailing humanity who turn to us for aid. For the care of the sick implies more than the use of the knife, the prescription of drugs or the employment of systems of therapeutics. There is a relationship between doctor and patient which cannot be charted or diagrammed. It awakens pity and sympathy and kindliness on the part of the one and begets faith and hope and trust in the other. This is not inconsistent with accurate diagnosis and scientific treatment. The modern medical student is turned out on the world excellently versed in all the medical sciences, considerably less versed in the medical arts, and totally unversed in the treatment of patients as anything but "cases" to be handled by rule of thumb. Ailing humanity cannot be so handled; body and soul cannot be separated for purposes of treatment. They are one and indivisible. Mankind's eternal cry is for release; the physician must answer it with something better than a test tube or a faultless technic. The cure which really means the care of the sick, the relief of suffering, the salvation of life—these are the high aims of the medical profession.

At the opening of the new building of the Boston Medical Library in 1891, Osler made this statement, "For the general practitioner, a well-used library is one of the few correctives of the premature senility which is apt to overtake him. Self-centered, self-taught, he leads a solitary life, and, unless his everyday experience is controlled by careful reading or by the attrition of a medical society, it soon becomes a mere accretion of isolated facts, without correlation. It is astonishing with how little reading a doctor can practice medicine, but it is not astonishing how badly he may do it. Not three months ago a physician living within an hour's ride of the Surgeon's Library brought his little girl, aged twelve, to me. The diagnosis of infantile myxedema required only a half glance. In placid contentment he had been practicing twenty

years in 'Sleepy Hollow' and not even when his own flesh and blood was touched did he rouse from an apathy as deep as Rip Van Winkle's sleep. He had not been a reader, he said, but he was a practical man with very little time."—*Hall, in J. Internat. Coll. Surgeons, 9:456, July-August, 1946.*

Electrolytic Absorption of Bone

Because of the danger of progressive bone absorption from electrolysis Venable has warned against the use of vitallium and stainless steel screws or plates in the same operation or even in the same bone at different operations. The cases illustrated here indicate that the danger of electrolysis perhaps is even greater when different types of stainless steel are used.

Under present conditions it is necessary for the surgeon himself to be responsible for the quality of the prostheses which he uses for the internal fixation of bone. He cannot depend upon the hospital in which he works . . . [because] . . . the correct length of screw is not always available. Only a few days ago while I was applying a bone plate to a tibia, it was necessary to stop and check the screws in the Zimmer screw and drill rack. When purchased, this rack was filled with an assortment of 18-8 S-MO stainless steel screws of uniform diameter and thread with the standard type of head. When checked, on the sterile instrument table, it contained some vitallium screws and 5 different types of stainless steel screws mixed indiscriminately, and the 1⅛ inch screws which were appropriate for the bone in this particular operation were missing entirely; their slot and an adjacent slot were filled with screws 1¼ inches long.

In addition to the heterogeneous mixture on the rack, there were probably a dozen other types of screws and plates in the operating rooms, some of which were purchased in 1912 when the hospital was opened, and this hospital is not unique in this respect. Plates and screws do not deteriorate with age and as new ones are developed, they are purchased and added to the stock, but the old ones are not discarded and they are all mixed together. The average operating room nurse knows nothing of electrolysis and its effect on bone.

In the light of what is known about the deleterious effect on bone of electrolysis caused by the use of metals of different composition for internal fixation, it is just as important that the metals used for internal fixation of bone be standardized as it is that drugs be of uniform purity and potency. And, when a prosthesis like the Neufeld nail, which is patented and the

manufacture of which is controlled, is supplied with screws which are of different composition, what may we expect of prostheses which are purchased in the open market and are made by any one of a dozen or more manufacturers?

The surgeon can usually distinguish a vitallium prosthesis from one made of stainless steel, unless the former is polished, but he cannot differentiate stainless steels of varying composition at the operating table. It is again suggested that only stainless steel of a uniform composition be used for all prostheses which are to be used for the internal or external skeletal fixation of bone. —*Key, in Surg., Gynec. & Obst.* **82**:321, *March 1946.*

Amino Acids in Therapy of Disease

There are two sources of protein for meeting the needs of the body. One is that portion of body protein which can be mobilized for a particular need in time of emergency—called the reserve protein. The other is the main and ultimate source of protein, the exogenous intake, normally dietary.

Of the two general routes for supplying the exogenous protein needs in disease therapy, the oral route is shown to be preferable. The parenteral routes are shown to be valuable, even life-saving, when oral intake is impossible or inadvisable.

Mixtures properly prepared of the crystalline amino acids threonine, valine, leucine, isoleucine, lysine, tryptophane, phenylalanine, methionine, histidine, arginine, and glycine are adequate for the protein nitrogen needs and marked weight gain of patients over long periods of time. Given parenterally as the sole protein nitrogen intake these amino acids are adequate for nitrogen balance in human patients.

Histidine omission from a mixture of amino acids given intravenously to a patient with ulcerative colitis resulted in a negative nitrogen balance.

One amino acid mixture gave similar nitrogen retention and urinary nitrogen partition to that obtained with the protein hydrolysate amigen during a brief comparison. Neither was quite so well utilized parenterally as orally and neither was quite so well utilized orally as the better natural food proteins.

No toxicity to the unnatural isomers of 7 essential amino acids was demonstrated.

These crystalline amino acid mixtures are well tolerated subcutaneously as well as intravenously even in more than 12 per cent concentration in aqueous solution. It appears, moreover, that further improvements in tolerance can be made.

Phenylalanine has been shown to be a limiting factor in tolerance.

Marked clinical improvement occurred in a patient with chronic ulcerative colitis fed certain amino acid mixtures parenterally together with carbohydrate, fat, and accessories orally. No improvement occurred when the amino acids were also given orally.

The value of certain amino acid mixtures in the preoperative and postoperative nutrition of 2 patients was also demonstrated.

Plasma protein levels in the range commonly regarded as "low normal" may be found in patients showing virtually complete exhaustion of body protein reserves. A high protein intake actually measured and given to such a protein depleted patient with a chronically unhealed wound brought about complete healing after all other treatment had failed.—*Madden et al., in Surg., Gynec. & Obst. 82:142, February 1946.*

The Four Eras in Surgery.—The history of surgery may be classified rather distinctly in four categories or eras.

The first or Heroic Era: A rather surprising amount of surgery was done for centuries by men who knew little of anatomy or of psychology. Even the operations of cesarean section, of trephining and of opening the bladder for stone date far back. . . . Empirical knowledge of antisepsis during the first era related to the use of alcohols and balsams, before the nature of their action was known.

The second or Anatomical Era, anticipated by Vesalius, made slow progress because of prejudice until the days of John Hunter.

Then came the third or Pathological Era . . . introduced by the practical work of Lister based upon the experimental work of Pasteur. Knowledge of the life history of the microbe allowed surgeons to work with such a degree of safety that many who were ill-qualified to use a knife assumed responsibilities for which they were in no way prepared by judgment, experience or learning. . . . Another vice going with the virtues of third era surgery related to the length of time which men gave to any given operation deliberately. . . . Surgeons forgot what they knew about values of the sense of touch and began to work more and more by the sense of sight. . . . We believed that surgery had at last really reached its limitations . . . when Metchnikoff and Wright turned our thoughts toward phagocytes and opsonins.

The fourth or Physiological Era began to light up our horizon. The basic theory . . . is conservation of the natural resistance of the patient, turning him over to his phagocytes and antibodies as quickly as we can do it—a period of brief anesthesia and the least degree of surgical battle that will suffice.—Robert Morris, in *Am. J. Surg.*, 1927.